Vol. 15, No. 5 May, 1959

LUBRICATION ENGINEERING

DESIGN RESEARCH APPLICATION EDUCATION MAINTENANCE

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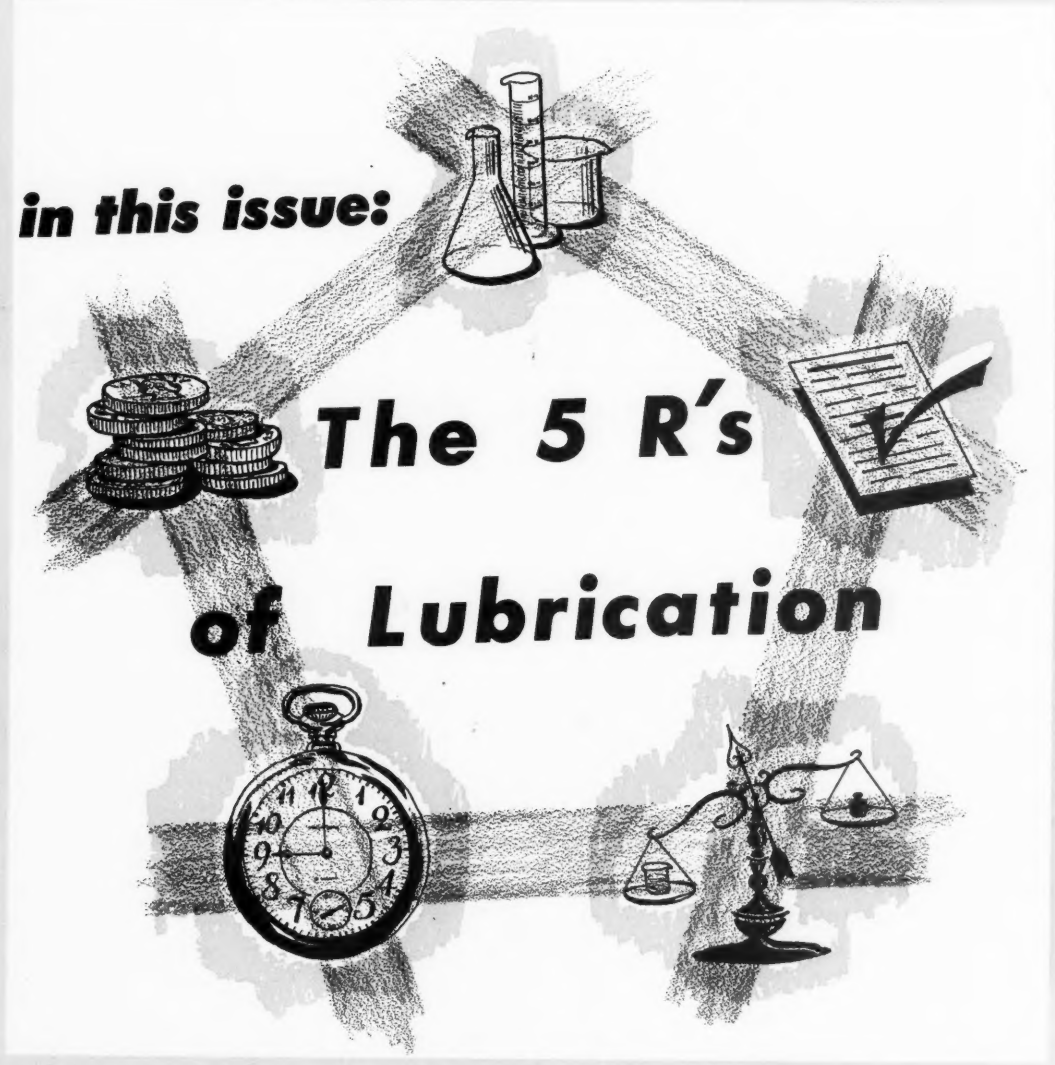
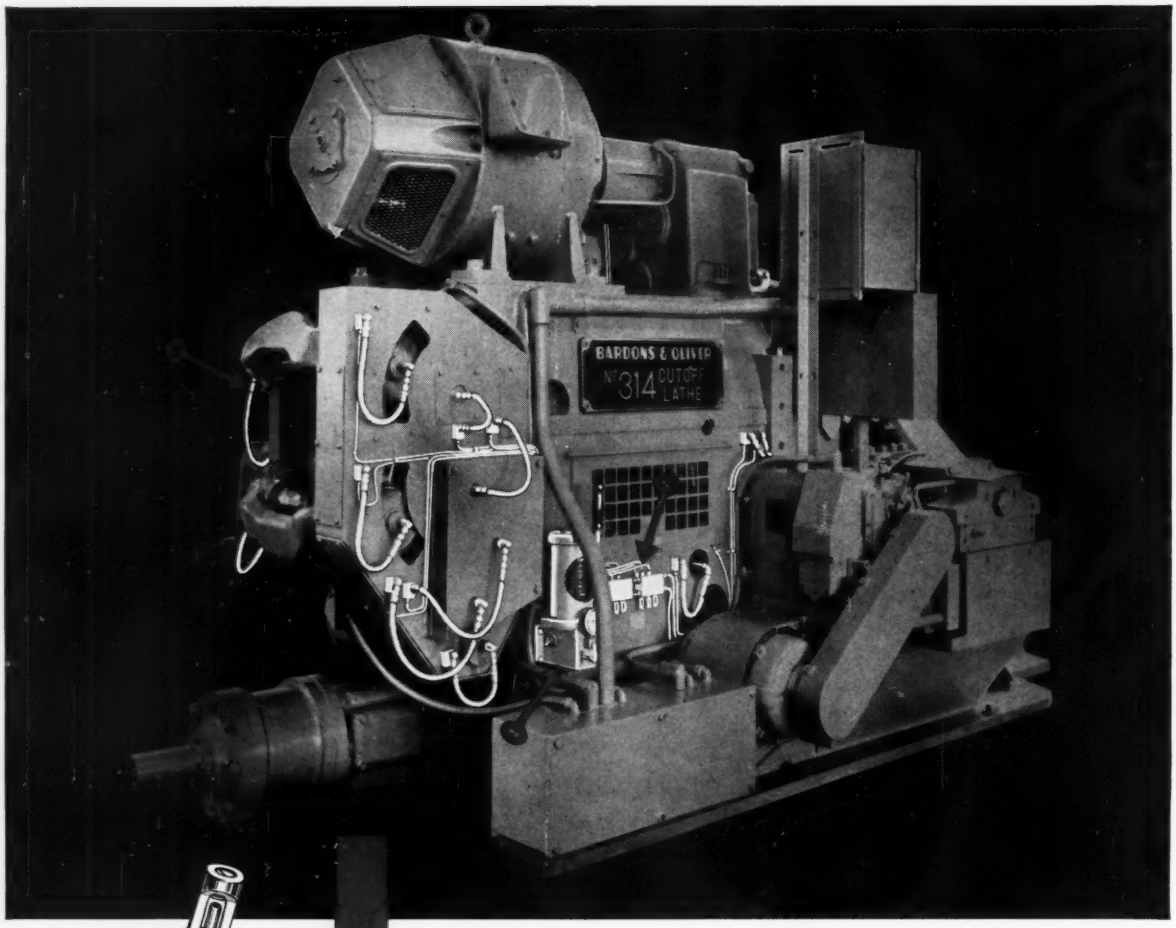
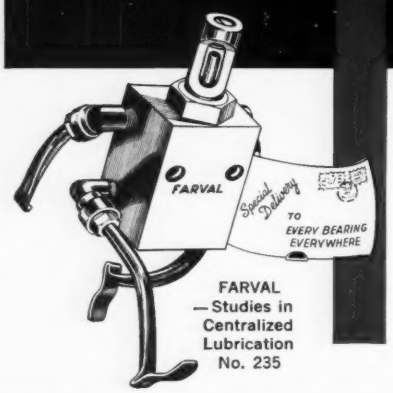


The 5 R's of Lubrication

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS





FARVAL
—Studies in Centralized Lubrication
No. 235

Farval lubrication keeps productivity high on cutting-off lathes

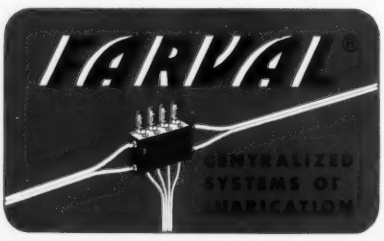
Cropping and chamfering steel tubing and pipe—as well as cutting-off and chamfering couplings ranging in diameter from 5 to 14½ inches—requires a heavy, rugged cut-off lathe like this Bardons & Oliver No. 314. It must be dependable in service—give high productivity—provide long trouble-free service life.

Bardons & Oliver design engineers chose a manually-operated Farval Dualine Centralized Lubrication System to serve the lathe's 39 vital bearings. During the last 7 years Farval has lubricated many of these B&O's—and there hasn't been a single known bearing failure to date!

Remember, a modern Farval system can adequately lubricate hundreds of bearings from one centrally-located pumping station. Why not check with your local Farval representative and see how these versatile lubrication systems can help produce superior, more productive industrial equipment. Or ask for your free copy of Bulletin 26-S—it contains the complete "Farval Story". The Farval Corporation, 3267 East 80th Street, Cleveland 4, Ohio. ®Reg. U.S. Pat. Off.

Affiliate of The Cleveland Worm & Gear Company
(Subsidiary of Eaton Manufacturing Company)

KEYS TO ADEQUATE LUBRICATION
—wherever you see the sign of Farval—familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine is being properly lubricated.



Volume 15, No. 5
May, 1959

Lubrication Engineering

DESIGN RESEARCH APPLICATION EDUCATION MAINTENANCE

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High Power Density Motor Drives Navy Robot 'Copter

Outlined and visible at rear of specially-fitted dual rotor Kaman robot helicopter is 240 hp high power density electric motor and associated oil cooling unit, developed for the "tethered" craft which is powered by cable from group supply generator.

An electric power plant of unique design is being utilized in operational testing of a specially-engineered dual rotor Kaman robot helicopter now under development for the U. S. Navy. Replacing a piston engine and providing equivalent power with a sizeable weight reduction, the "high power density" motor receives electrical input current from a trailer-mounted ground power supply generator through a flexible cable. Specific application of the unusual robot helicopter is classified.

Developing 240 hp with a weight of only 188 lb., the motor unit is a continuous duty oil and air cooled power plant said to incorporate unprecedented engineering design approaches. Key factors in the unusual efficiency of the motor units are: close integration of electrical, thermodynamic and mechanical functions; the use of new developments in high heat-resistant and heat-dissipating resinous varnishes; pressurized internal circulation of coolant oil through the rotor itself, and integral cowled-blower cooling providing air circulation over the entire motor unit.

July Lube Course Planned at M.I.T.

A special summer program at Massachusetts Institute of Technology will be held on July 16-26, 1959 in cooperation with ASLE. The program will cover concepts fundamental to the design of bearings of all types, including autolubricated and externally pressurized thickfilm bearings, rolling-contact bearings, and boundary-lubricated bearings. Emphasis will be placed on abnormal operating conditions involving, for example, extremes of temperature, pressure or speed. Recent developments in bearing materials and lubricants will be described against this background.

Lectures will be given in the mornings, while afternoons will be devoted to laboratory demonstration or to design and calculation sessions. Both participants and staff will take part in group discussions of topics of special interest.

Intended for engineers concerned with bearing design or with research on related problems, the program will be directed by Dr. Brandon G. Rightmire, Associate Professor of Mechanical Engineering. Guest lecturers from industry will be invited to participate.

Lubricating Oil Consumption Due To Increase in '59

Total demand for lubricating oils and greases manufactured in the United States will increase by 5 per cent this year over 1958 to a level of 151,000 barrels per day.

Thomas W. Phelps, manager of the economics department of Socony Mobil Oil Company, Inc., made this forecast before the National Petroleum Association at its semi-annual meeting in Cleveland, Ohio. He discussed "The Supply and Demand Prospects of Lubricants."

Analyzing the close relationship between the Federal Reserve Board index of industrial production and the use of industrial lubricants, Mr. Phelps estimated an increase of 10.3 per cent in this market. A rise of 10 per cent is expected in the Federal Reserve index.

He foresaw smaller increases for the other two principal markets for lubricating oils. He predicted a 3.9 per cent rise in exports. The greater mileage now being obtained from automobile lubes, he said, will limit the increase in the automotive market to 1.6 per cent.

On a regional basis, he predicted that the Middle West would show the best increase with a 6 per cent gain in lubricant demand. In the East and West coast regions, he expected a five per cent rise. Smaller gains of 3 per cent and four per cent respectively were forecast for the Southwest and Southeast.

Phelps traced the relationship between lubricant demand, domestic petroleum demand and the index of industrial production since 1925. He showed that while the lubricant demand index started at a higher level than the other indices, it now lags behind. Since 1950, the trend line in lubricating oil demand has remained almost horizontal.

Speaking of the conditions affecting the demand for automobile lubricants, he noted the "prodigious" increase in car registrations since 1925. But automotive lubricants are either "a lot more efficient" or being used "more economically." Actual use of lubricating oil per vehicle has declined sharply—by 40 per cent, during the past 10 years.

He predicted the U. S. oil industry would increase production of lubes by more than nine per cent this year, leaving about 16 per cent of the total lubricating oil production capacity unused.

NATIONAL OIL SEAL LOGBOOK

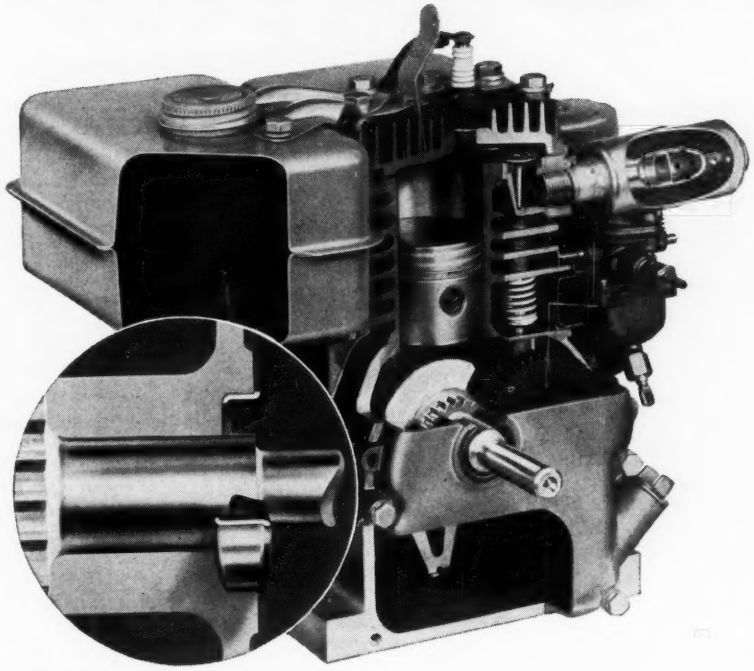


Figure 1.

Zero leakage oil sealing a "must" in Briggs & Stratton 2¾ hp engine

Some oil sealing applications can accept a small amount of lubricant leakage or "seepage." But not the Briggs & Stratton 8B Engine. Here, on a ⅞" crankshaft turning up to 3,600 RPM, light engine oil must be positively sealed in the crankcase at both front and rear bearing points. Oil temperature is 200° F with the engine at wide open throttle; and external temperatures may range from —30° to 125° F. Many Briggs & Stratton 8B engines operate only after long periods of inactivity; others are used continuously, a variable which makes the sealing problem even more demanding.

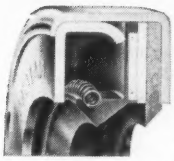
Satisfactory sealing and long, trouble-free service life is obtained by use of two special National Syntech® synthetic rubber seals (Fig. 1)—one at either sealing point. These precision made Syntechs have a minimum-contact sealing lip seating lightly but firmly on the shaft. The steel outer case is a precise press-fit for the bore, simplifying installation and preventing accidental working free of the seal.

National pioneered Syntech synthetic rubber seals; today offers a complete line of Syntech and leather seals plus convenient, competent oil seal engineering assistance. For data, for practical design help, call the National Seal engineer. He's under Oil Seals, in the Yellow Pages.

Variations on basic oil seal designs

10,000-S

Many modifications of the basic National spring-loaded Syntech oil seal design are offered. For example, where external conditions require a felt dust baffle, National 10,000-S may be employed. Where dirt or grit conditions are severe, a National 20,000-S with leather or Syntech auxiliary sealing lip is often used.



230,000-S

For applications where shaft entry is made from the auxiliary side, a National 230,000-S seal with auxiliary leather washer-type sealing lip mounted *in tandem* is suggested.

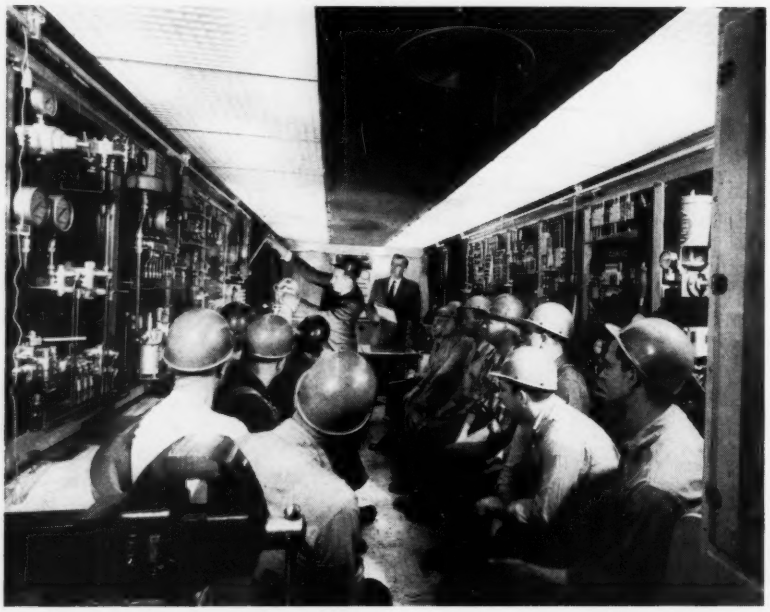
70,000-S

For positive separation of low viscosity fluids at higher speeds and temperatures, National 70,000-S series seals are suggested. Basically two 50,000-S seals mounted with sealing lips opposed, this seal may be used at temperatures above 250° F and speeds in excess of 2,000 FPM.

Altogether, National offers over 2,500 basic types and sizes. There is one best seal for a given application. Your National engineer can help you obtain it.

NATIONAL SEAL

Division, Federal-Mogul-Bower Bearings, Inc.
General Offices: Redwood City, California;
Plants: Van Wert, Ohio, Downey and Redwood City, California



Fifteen or more persons can be seated comfortably for demonstrations inside the mobile training unit which is being used by U. S. Steel to instruct employees in maintenance of plant lubricating systems. The 35-foot vehicle contains operating components of centralized lubricating systems. Here John Simon, National Tube lubrication engineer, and V. C. Sutcliffe, general supervisor of training at National Tube's National Works, demonstrate a system to employees of National Works.

"Class on Wheels" Acts as Lube Clinic

United States Steel has put a traveling classroom into service to give its employees theoretical knowledge and practical job know-how in the proper maintenance of plant lubricating equipment.

The classroom is a 35-foot mobile training unit, equipped with all the components of a centralized lubricating system.

Built by U. S. Steel's National Tube Division, which has the responsibility for lubrication research for the Corporation, the unit is mounted on a bus chassis so that it can be driven to any plant location.

The specially constructed steel body seats as many as 15 people for demonstrations. Along both walls are removable panels upon which are mounted operating lubricating system components. These can be plugged into a built-in lubrication reservoir for "live" demonstrations with actual lubricating materials. Work benches are located at each end of the demonstration area. The mobile unit is fitted with every type of lubricating equipment used in U. S. Steel plants. Employees at any plant thus can be given instruction on equipment identical to that in operation at their particular plant location. Demonstrators can convert from one type of equipment to another simply by placing different panels in the wall mounts.

The mobile unit carries its own generator and can operate independent of outside power. However, it can be plugged into a plant power source where this can be done conveniently.

New CBBI Manual Simplifies Design Of Sleeve Bearings

Bearing designers and users will be able to design with confidence using the latest theoretical and experimental sleeve bearing design information available, members of the Cast Bronze Bearing Institute agreed following their review of the latest draft of the CBBI technical manual. Meeting in Chicago at the Sherman Hotel April 13, representatives of member firms studied and approved the revisions and added sections presented by Harry Rippel, project engineer, Friction & Lubrication Section of the Franklin Institute, Philadelphia, who is directing preparation of the manual.

The new manual, designed to take guess-work and rule-of-thumb factors out of sleeve bearing design, should increase markedly the application of cast bronze bearings since it radically simplifies and shortens the designer's work, according to CBBI President G. F. Langford. This outstanding contribution to the design field, he noted, substitutes equations and graphs for the time-consuming trial-and-error methods. Mr. Langford outlined the need for and development of the manual at a brass and bronze session of the American Foundrymen's Society in the Sherman Hotel April 14.

Containing some 70 figures and charts, the CBBI bearing design manual covers the entire field of full-film, complete boundary, and mixed film sleeve bearing applications. In addition, the manual in-

Proper maintenance of plant lubricating systems will be learned in this mobile training unit, which was built by National Tube Division. Here, L. F. Sattele, general superintendent of National Tube's National Works, and John Simon, National Tube lubrication engineer, examine the 35-foot traveling classroom as it prepares to take to the road on a tour of U. S. Steel plants.

Greases made with

BARAGEL*

. . . keep conveyor equipment moving!

BARAGEL greases lubricate conveyor equipment . . . of any type . . . under any working conditions; hold shutdowns to a minimum.

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BAROID CHEMICALS, INC.

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*BARAGEL is a registered trademark of National Lead Company for organic ammonium montmorillonites.

JOHN BUTLER TYTUS *dreamed that steel could be rolled in a continuous strip. In 1904, fresh from Yale University, he went to work as a laborer in the rolling mill to learn the craft, rose to mill superintendent and worked out the techniques and blueprints of his continuous rolling mill during World War I. It took him until December, 1923, to build the first mill and another six months of trial operation to produce satisfactory sheets. Today, billions of dollars worth of smooth-finished, deep drawing sheets roll at ever-increasing speeds from the continuous mills of America.*

Great Names in Steel Making

Most of the public which now benefits from the quality and lower cost of continuous rolled steel has never heard of John Butler Tytus. But, among men who make steel, his is a great name.

There are names of other men and products equally unknown to the public but of important significance in the steel industry. "Palmoshield" is an example.

Midway in the Korean War (March, 1952) Fortune magazine carried the first report of Palmoshield: *"New All-American Lubricant Frees Rolling Mills from Hazards of Foreign Supply."* Before that year ended, millions of pounds of domestic Palmoshield had replaced imported palm oil for tin plate rolling in both American and Canadian mills.

Palmoshield proved so satisfactory that its use has multiplied again and again — not only for tin plate rolling but also for light and intermediate gauge sheet, long terne and coating lines. It not only has brought independence from overseas supply sources, stockpiling and artificial price fluctuations, but has provided a closely controlled, always uniform roll oil, specially compounded to fit the user's preferences and particular method of application. Many mills have increased their production through its use.

Other Ironsides "Shield" lubricants have been highly regarded by steel makers for nearly 70 years. As with Palmoshield, Ironsides engineers are prepared to "custom tailor" Roll Neck Shield" or E.P. "Roller Bearing Shield" to meet each mill's problems arising from today's insistent demand for higher quality of product and greater speed of mill production.

If you have a lubrication problem, we'd like to help you lick it. Just write, or telephone, The Ironsides Company, Columbus 16, Ohio.

JOSEPH MARCUS.

NEW PRODUCTS

METER MEASURES SURFACE-TEMPERATURES

The Royco Pyrotom, an inexpensive instrument for making ± 2 per cent full-scale accuracy temperature measure-

ments is available in two types: 1) automatically compensated for ambient temperature or 2) non-compensated type for relative temperature readings. Model DTF is a compensated type available in ranges 0-300, 0-540, and 0-650 F. The non-compensated type, Model ETF, is available in the 0-200 C range only. Of special interest for checking operating temperatures of electronic components is a special 15-deg side-reading probe for hard-to-reach surfaces such as those of resistors and capacitors on parallel mounting boards. All types are self-contained and ultimate temperature response is attained in three to 10 seconds, depending on surface character. For more information contact Royco Instruments, Inc., 874 Fabian Way, Palo Alto, Calif.

900F BEARINGS AVAILABLE

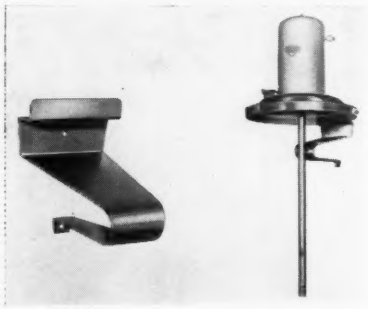
Deep groove radial bearings for applications up to 900F. are now carried in stock in three R-series sizes by Industrial Tectonics, Inc. (R-2: bore .1250 inch, O. D. .3750 inch); (R-3; bore .1875 inch, O. D. .5000 inch); (R-4: bore .2500 inch, O. D. .6250 inch). The bearings are manufactured to ABEC-5 tolerances. Material for balls, races and retainers is high speed tool steel. Retainers are machined, and of snap-in type construction. A price list with additional dimensions and specifications, and an application analysis questionnaire will be mailed upon request from Industrial Tectonics, Inc., 3686 Jackson Rd., Ann Arbor, Mich.

QUICK-CHANGE FILTERS

A new line of "Quick-Top" hydraulic filters, which, the manufacturer claims, cuts preventive maintenance time 90 per cent, has been introduced. Time-saving is based on a unique closure device that reportedly permits filter elements to be changed in less than a minute. The closure consists essentially of a hand removable cover which is held in place by a spring steel retainer ring. Using only a screwdriver, the retainer ring can be lifted and the cover removed in less than 10 seconds. The dirty or clogged element can be removed and replaced and the cover sealed back in place in less than a minute. Conventional filters, having bolt-down covers, are said to require 10 minutes minimum for the same operation. For use with hydraulic oils, fuels, solvents, lubricating oils and other fluids, the filters have been designed to use standard AN-6236 elements. Complete technical details, price and delivery information are available from the Test Equipment Div., Consolidated Diesel Electric Corp., 1 John St., Stamford, Conn.

WALL BRACKET HOLDS PUMP

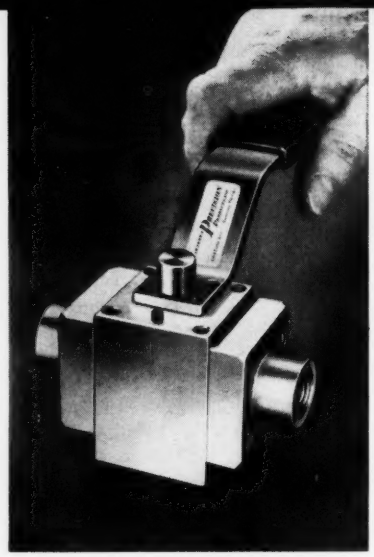
A new pump support wall bracket, designed to hold a lubricant pump off the floor while drums are being changed, has



been developed by Lincoln Engineering Co., St. Louis. The bracket, of heavy 16-guage sheet steel, zinc-plated to resist corrosion, eliminates the need for pump elevators or hoists. The operator hooks the drum cover flange on the bracket while he slides in a fresh drum of lubricant. Since the pump tube is held free of the floor, it cannot be contaminated by dirt. The bracket includes two mounting holes, top and bottom, for securing to any type surface with 5/16 in. dia. bolts or screws. For additional information write for Bulletin 540.

VALVE SOLVES PROBLEMS IN HYDRAULIC CIRCUITS

A new holding valve, engineered to solve special problems in hydraulic circuits, has been developed. The valve performs these basic functions: locks a cylinder or motor when no motion is desired; prevents load from running ahead of the oil supply when the load is being moved, and relieves excessive pressures generated in the cylinder by load



and in case of power failure it permits the load to be lowered manually. The advantages this valve has over the counterbalance type valve are its nominal use of power when a load is elevated or lowered. It is said to offer advantages of quiet and smooth operation which cannot be obtained from a conventional seated ball pilot check valve when used in a circuit where the load may run ahead, it is used to perform the same functions. Further information can be obtained from Sarasota Precision Products, Inc., 1314 N. Lime Ave., Sarasota, Fla.

VALVE CUTS CONTAMINANTS

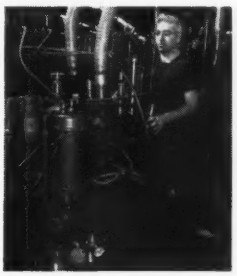
A Vari-Speed control valve, is a combination needle and ball-check valve. Used to control the speed of a single or double-acting air or hydraulic cylinder, the valve restricts flow from the exhaust end of the cylinder during piston movement in one direction. Movement in opposite direction unseats the ball check and bypasses the needle-valve section. The valve controls fluid volume only and has no effect on incoming pressure or cylinder-output force. Controlled flow, with the ball check seated, is directed from the large end of the needle valve to the small end. The large-diameter needle and the direction of fluid flow combine to provide a reportedly smooth, nonturbulent flow which is largely unaffected by dirt or scale and can be controlled with great precision. In the free-flow direction, flow is unrestricted around the ball check. In the controlled-flow direction, the ball is seated and flow is directed through the restricting orifice around the needle valve. Aluminum valve bodies withstand pressures to 2000 psi. All other parts are stainless steel. The needle has an O ring and lock nut for leak-proof trouble-free performance without frequent adjustments. Vari-Speed valves are available for pipe sizes from ⅛ to ¾ in. from Control Line Equipment, 19560 Center Ridge Rd., Cleveland 16, Ohio.

THE MAGIC OF *Norgren* MICRO · FOG LUBRICATION

✳ Bearing Temperatures Reduced 10° to 20° F.

At Charlotte Pipe & Foundry, Charlotte, No. Carolina, four machines for centrifugally casting soil pipe were converted to Norgren Micro-Fog Lubrication. Results: • Saves 216 gallons of oil a week. • Ended flash fires resulting from oil leakage. • Eliminated ¾ hp pumps on oil circulating system.

✳ Milling Accuracy Improved — Rejects Reduced



A leading automotive equipment manufacturer uses Norgren MICRO-FOG to replace grease packed lubrication method which caused machine to run so hot after one hour that the guide rods expanded, resulting in machining inaccuracies. Now . . . with Norgren MICRO-FOG Lubrication: • Heat problem has been eliminated—after 8 hours of continuous operation, the machine runs at a temperature only slightly above ambient. • Milling accuracy has been greatly improved. • The number of rejects has been substantially reduced.

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ASLE MEMBERSHIP CLASSIFICATIONS

Membership in the American Society of Lubrication Engineers is in several grades as defined below. Assignment to grade is made by the Admissions Committee or Board of Directors on the basis of information submitted by the applicant.

Members: Members shall be persons not less than 24 years of age who: (1) are engaged in research and instruction at technical schools, universities, and various publicly and privately supported institutions in the field of lubrication; or (2) have occupied recognized positions as lubrication engineers for a period of three or more (not necessarily consecutive) years prior to date of admission, involving the responsibility for or supervision of the development, selection, field use and application of lubricants as differentiated from other activities; or (3) are indirectly concerned with the field of lubrication, but possessing other qualifications of experience, knowledge, and accomplishment, and have manifested a particular interest in the purposes and welfare of the Society to the extent that their membership would be a valuable contribution to the successful functioning of its activities. Fee 15.00.

Associate Members: Associate Members shall be persons less than 24 years of age, and those who do not completely fulfill the membership requirements for Members. Fee $7.50.

Sectional Sustaining Members: are such persons or organizations as may be interested in and desire to contribute to the support of the purposes and activities of a local Section of the Society. Fee $25.00.

Industrial Members: Industrial Members are such persons or organizations as may be interested in and desire to contribute to supporting the purposes and activities of the Society. Fee $150.00.

For application blanks or further information, write:

ASLE
84 E. Randolph St.
Chicago 1, Ill.

PRODUCT LITERATURE

CATALOG LISTS VALVES

Atkomatic's new catalog lists its complete line or more than 200 solenoid valves of bronze and stainless steel construction. Valves are available for use with pressures from 0 to 10,000 psi and temperatures from −300 to +500F and may be used for air, steam, corrosive and noncorrosive gases and liquids. The 36 page catalog gives detailed valve specifications, performance data, specific application information and optional features. Cutaway drawings are used to identify valve parts and illustrate valve operation. All material is organized and presented in such a manner as to be of maximum assistance to the equipment and systems design engineer. Prices are included to simplify cost estimating. The new catalog is available from Atkomatic Valve Co., 545 W. Abbott St., Indianapolis, Ind.

SILICONE RUBBER BULLETIN

RTV (room temperature vulcanizing) silicone rubber, recommended for electrical potting and encapsulating, for flexible mold-making materials, and for high and low temperature sealing and caulking, is described in CDS-170, a new bulletin now available from the Silicone Products Dept., General Electric Co., Waterford, N. Y. The bulletin includes complete product and application data for three new RTV compounds which are said to have a number of advantages, including better physical properties and heat resistance, over previously available room-temperature curing elastomers.

FOLDER DESCRIBES COOLANTS

A four-page folder, "The Evolution of a Modern Cutting Fluid," is available from E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa. The booklet describes the development of coolants from water to oil to fortified petroleum bases, then to heavy-duty water-soluble concentrates, and now to chemically conceived coolants containing no petroleum. Hocut 237 is described in terms of its reportedly long life, freedom from rancidity, rust protection and lubricity. It does not depend on oil for its lubricity nor on sulphur or chlorine for load-carrying ability.

RUBBER STUDIES PUBLISHED

Two new studies have been published describing the resistance of Butyl rubber compounds to ozone and to fire-resistant hydraulic fluids. Bulletin 105-1 reports the results of a study of a number of antiozonants, antioxidants, sunproofing waxes and other materials suggested as additives for further improving Butyl's ozone resistance. In most instances the tables of data show test results for both mold- and steam-cured compounds. A second study, Bulletin 102-1, demonstrates the resistance of Butyl rubber to a number of commercial fire-resistant hydraulic fluids. Tables and graphs are included illustrating the effects of immersion temperature on the volume swell and physical properties of Butyl rubber. The study also includes a comparison of the resistance of Butyl compounds cured with a typical sulfur system and a dimethylol phenol resin system. Both Bulletins 105-1 and 102-1 are available upon request from Thiokol Chemical Corp., 180 N. Clinton Ave., Trenton 7, N. J.

PATENT ABSTRACTS OFFERED

A 28-page compilation of abstracts of patents and journal references on dimer acid is offered by Emery Industries. The booklet contains abstracts of 113 United States patents and 27 published articles dealing with the use and application of the acid, which is a mixture of relatively high-molecular-weight dibasic and tribasic acids. Fields of use covered by the patents and articles include polymers, surface coatings, urethane foams, rust inhibitors and viscosity improvers for lubricants, synthetic fibers, waxes and adhesives, among others. For a copy of the abstracts, write Emery Industries, Inc., Dept. 5, Carew Tower, Cincinnati 2, Ohio, and request a copy of Technical Bulletin No. 412.

SLUDGE REMOVAL EXPLAINED

Printed in four colors, "Westfalia Automatic De-Sludgers" explains how continuous centrifuges can purify fuel and lubricating oils, food and food byproducts, chemicals, pharmaceuticals and other products. The eight-page bulletin pictures five models of this type of equipment and employs detailed cross sections with shading in colors to show the details of the flow of the feed, sludge, and purified streams. Various models are compared in the same way and the complete operating cycle of the automatic sludge discharge mechanism is also pictured. Featured in the bulletin is a table showing capacity of each of these five models for desludging various materials. Model SAOG-4016, for example, will purify up to 1200 gph of motor testing stand oil or up to 950 gph of drive fuel oil, among other products. Pictures and drawings illustrate the machines and their construction as well as showing typical hook ups. Copies of the bulletin (No. 2177) are available from Centrico, Inc., 75 W. Forest Ave., Englewood, N. J.

Lube Lines

by A. F. Brewer*

STANDARDIZATION

One of the most popular and practicable contributions to the program of effective lubrication of almost any machine is standardized simplification, commonly known as "simplified lubrication." Several publications recently have dealt with this subject. This boon to management reduces storage and inventory problems as well as eliminating the possibility of misuse of lubricants.

But neither standardization nor simplified lubrication can be approached casually, or seized upon as a cure-all. Too many contingencies must be considered. One might think that a diesel engine oil could be regarded as an all-purpose internal combustion engine oil, but this is not necessarily so. As another example, a steam cylinder oil specifically recommended for a certain range of steam pressure and moisture conditions may not necessarily be suited for the worm gear sets in the plant.

This all points up the necessity of balancing operating conditions against the characteristics of the lubricants being considered. Information regarding the nature and properties of any lubricant is normally obtainable from the refiner who also can give advice on the lubricant's chemical makeup with respect to prospective operating temperatures. The question to be answered is whether the prospective lubricant is fortified with suitable additives to retard oxidation, impart added film strength, or other features such as foam resistance.

Uniformity of product is most essential. The petroleum chemist realized this very early. Around the turn of the century, when petroleum was replacing animal and vegetable oils as the most practicable source of lubricants, certain standardized tests were adopted as the process of refining was developed. These tests—physical in nature—still constitute the yardstick by which the oil refiner attains uniformity of finished products. Viscosity is the guide to the body or relative fluidity of an oil. Pour point indicates how it behaves at low temperatures. Carbon residue denotes what will remain after continued exposure to very high temperatures. These and other tests such as flash point, fire point, and color make up today's usual

PERTINENT DESIGN AND OPERATING DETAILS

Bearings

Sleeve Type

Bearing metal	Operating temp. range °F.	Type of lubrication	Type of lubricant	Viscosity range or consistency

Ball or Roller

Design and type	Operating temp. range °F.	Type of lubrication	Type of lubricant	Viscosity range or consistency

Reduction Gears

Type and housing	Operating temp. range °F.	Type of lubrication	Type of lubricant	Viscosity range

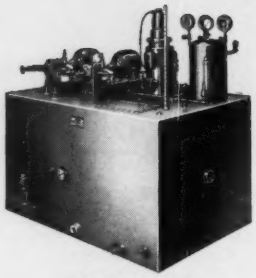
Note: This same scheme of data presentation can be followed for chain drives, flexible couplings, power transmission units and geared motor drives.

specification for a lubricating oil. They are useful as control tests during the refining process. Their significance is ably presented by The American Society for Testing Materials in "The Significance of ASTM Tests for Petroleum Products."

More important than any of these conventional tests, however, (for hydraulic and steam turbine oils as an example) is testing for oxidation stability. The petroleum industry uses a number of laboratory tests for this purpose. These vary as to method of procedure, use of catalysts or accelerating oxidizing materials, and length and time and temperature. It would be virtually impossible for the average purchaser of such oils to specify and install laboratory apparatus to check such tests. He therefore must rely on the integrity of his lubricant supplier and on records of past performance for whatever lubricants he plans to use.

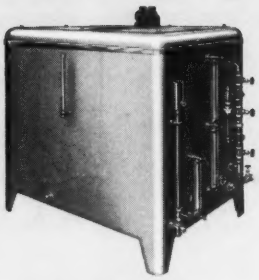
Operating conditions must also be studied and cataloged by the prospective user. He could arrange for an independent survey of his plant for this purpose, or call in the lubrication engineer from his lubricant supplier to gather this data. But he will facili-

(Cont. on p. 216)



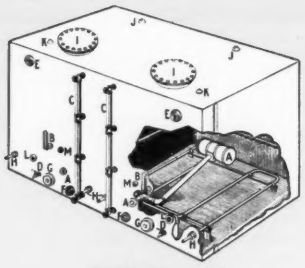
SPACE SAVING LUBRICATION SYSTEM

Figure 829 Self-Contained Lubricating Units offer a complete oil circulating and filtering system . . . compactly designed with filter, pumps, pressure tank, piping, alarms, gauges, etc.



OIL CONDITIONER

Figure 832-P — Filters and conditions turbine and other low viscosity, high demulsibility oils . . . without aeration, turbulence, heat or the use of moving parts.



RECEIVING AND STORAGE TANKS

Figure 363 — Two-Compartment Storage Tank permits precipitation of dirt and water from one batch while other batch circulates through system. Capacities 300 to 8,000 gallons.

Figure 360 — Receiving Tank receives dirty oil by gravity . . . precipitates dirt and water before pumping to filter. Capacities 100 to 6,000 gallons.

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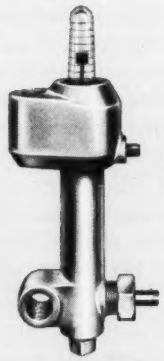
Gentlemen: Please send prices and detailed information on:

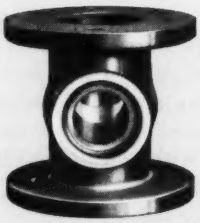
- ☐ Figure 829 Lube System
- ☐ Figure 823-P Oil Conditioners
- ☐ Receiving & Storage Tanks
- ☐ Figure 818 Oiler
- ☐ Flow Sights
- ☐ Teleflow Indicator

(Attach to your letterhead for quick response.)



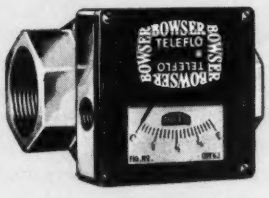
SIGHT FEED OILER

Figure 818 — Pressure-type oiler features location of indicator outside the liquid body making it ideal for use with dark liquids.



FLOW SIGHTS

Double window flow sights for vertical installation on gravity flow lines. Flow is clearly visible . . . glasses do not cloud.



TELEFLOW INDICATOR

Figure 815 offers easy reading graduated dial for close approximation of liquid in flow. Vane type indicators also available.

Intensification of Research Effort Needed on Boundary Friction and Wear

Boundary friction and wear, the greatest source of industrial waste and the strongest single barrier to any substantial increases in the productivity of our machinery, is still a very complex phase of engineering.

It is a national military and industrial problem.

The slow progress in this particular phase of engineering can be attributed to the delayed recognition of the seriousness and complexity of the problem, to educational neglect, and to the refusal of engineering as a whole to accept responsibility for these deficiencies. The solution was thought to be the primary responsibility of the lubricant manufacturers.

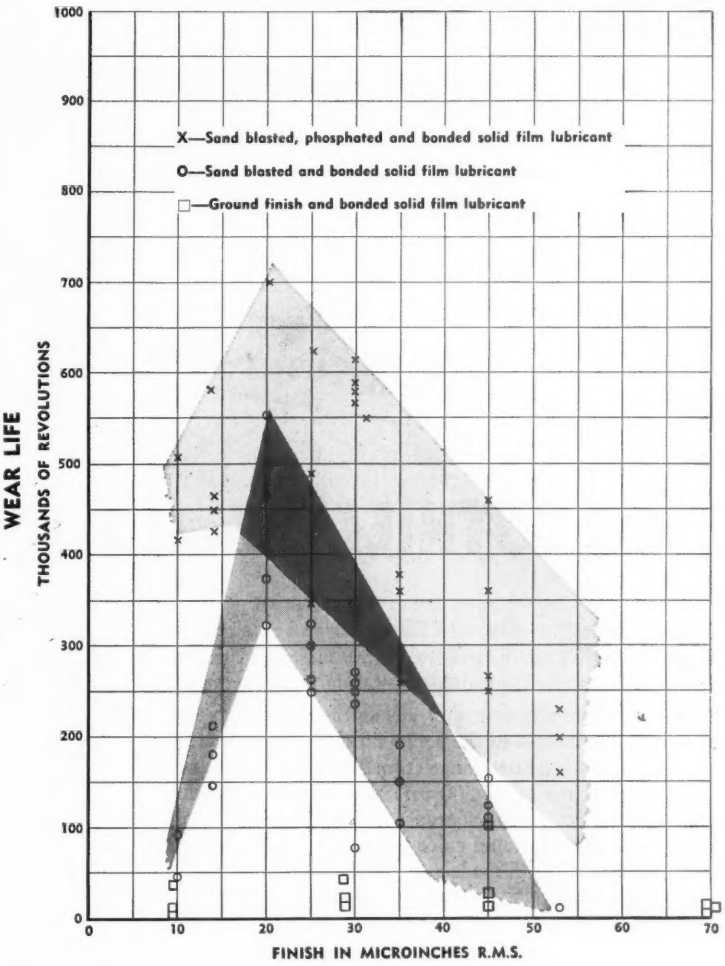
As one of these lubricant manufacturers, we take this responsibility seriously. After years of experience, we have found that the eventual elimination of boundary friction and wear as a complex will be based on *testing . . . testing . . . and more testing.* We feel that it is unrealistic to complain that the few E.P. testing machines in use do not solve the whole complex for us.

We want all the reliable testing machines we can afford and we now have 14 of one type, our Model LFW-1, in operation. Finally, we are beginning to see light after more than 100,000 testing hours on these machines. Yet, we realize that we have only begun to scratch the surface!

For example, it took 7,000 testing machine hours to plot the chart on this page which indicates the significance of surface finish and the methods used to produce it. A sharp wear-life peak appears for surfaces ground to 8 to 10 microinches r.m.s. and then sandblasted to a 20 microinches r.m.s. finish. It drops off sharply for finer or coarser finishes produced with other sizes of blasting media. Wear life is lowest for ground finishes.

Of course, surface roughness is only one of the many ingredients which make up the complexity of boundary friction and wear. A large number of these ingredients has shown up in our test data and will have to be investigated separately.

To complete the study of the effect of the surface finish alone for conditions other than those used in our tests, such as: a large variety of mating metal combinations, bearing pressures, sliding velocities, etc., an estimate of 4,000,000 testing machine hours is probably on the low side.



WEAR LIFE VERSUS SURFACE FINISH curves show the significance of surface finish and the methods used to produce it. Tests were run on Alpha Model LFW-1 testing machines. The following key indicates the testing procedures used: X shows results of samples which were ground to 8 to 10 microinches r.m.s. and then sandblasted to finish shown. After sandblasting, these samples were phosphated and then coated with a bonded solid film lubricant; ○ shows the results on samples which were ground to 8 to 10 microinches r.m.s., sandblasted to the r.m.s. finish shown and then coated with a bonded solid film lubricant; □ shows results on a ground surface coated with a bonded solid film lubricant.

About half of the energy produced in the world today is consumed by boundary friction and billions of dollars yearly are lost to boundary wear. Even if we are willing to accept these losses, we can hardly accept the condition where tremendous engineering advances are made in other fields only to be retarded by the slow progress in the field of boundary lubrication.

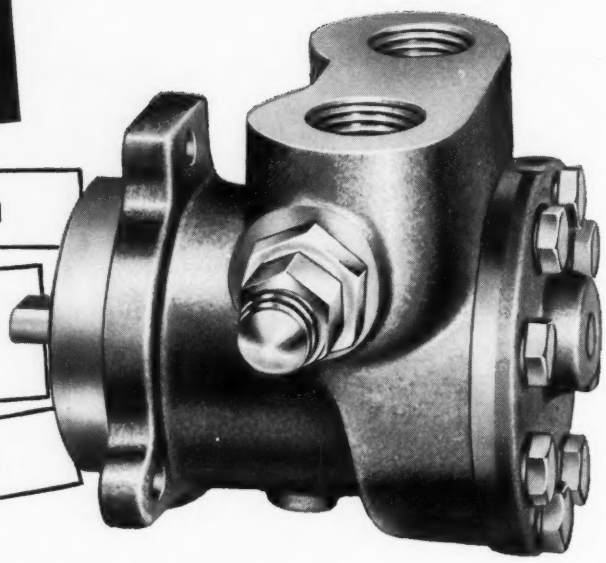
The Alpha-Molykote Corporation, 65 Harvard Avenue, Stamford, Connecticut, manufacturers of MOLYKOTE® Lubricants and Alpha Lubricant Testing Machines.

NOW

Compact design

Complete mounting interchangeability

Built-in relief valves



on TUTHILL small industrial pumps

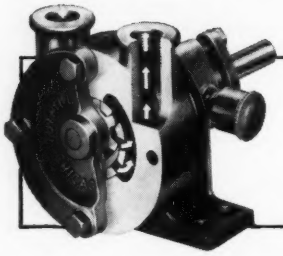
Now a new design—Series LPFV—gives you even greater flexibility with Tuthill small industrial pumps . . . the industry standard for dependable operation for many years.

Complete interchangeability allows the use of any one of five different sizes in the series on the same mounting arrangement. Capacities range from 20 to 360 gallons per hour, at pressures up to 500 psi. Normally provided for 1800 RPM, 3600 RPM speeds are permissible in most cases. And a built-in relief valve is now offered as optional equipment on all LPF models.

Compactness, an outstanding characteristic of all Tuthill pumps, is particularly exemplified in the new model LPFV with its shorter mounting hub. It is also available in close coupled motor-pump combinations for applications where space and weight are at a premium.

The newly designed model LPFV incorporates the performance-tested operating characteristics of Tuthill's internal gear construction described at right. In thousands of applications . . . in hydraulics, lubricating, transfer, circulating and other services . . . Tuthill internal gear pumps have established enviable records for reliability and quiet operation.

Over 700 models of Tuthill internal gear pumps are available to provide one especially suited to your application. These include stripped models for built-in applications, cartridge pumps, reversible models . . . a host of specialized pumps for each individual service. Mail the coupon today.



TUTHILL internal gear pumping principle

In Tuthill internal gear pumps, proven in 30 years of operation, there are only two moving parts. The principle is based upon the use of a rotor, idler gear and a crescent shape partition cast integral with the cover. Power applied to the rotor is transmitted to the idler gear with which it meshes. The space between the outside diameter of the idler and the outside diameter of the rotor is sealed by the crescent. As the pump starts the teeth come out of mesh increasing the volume. This creates a partial vacuum drawing the liquid into the pump through the suction port. The liquid fills the spaces between the teeth of the idler and the rotor and is carried past the crescent partition to the pressure side of the pump. When the teeth mesh on the pressure side the liquid is forced from the spaces and out through the discharge port.

Tuthill Pump Company
971 East 95th Street
Chicago 19, Illinois

☐ Please forward information on LPF series
☐ Please have your representative call

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Tuthill Manufactures a Complete Line of Positive Displacement Rotary Pumps in Capacities From 1 to 200 GPM; for Pressures to 1500 PSI; speeds to 3600 RPM.

PUMPS FOR YOUR PURPOSE

TUTHILL PUMP COMPANY

971 East 95th Street, Chicago 19, Illinois

Vol. 15, No. 5

Lubrication Engineering

looking ahead with ASLE

The swami, the weather forecaster, the alert sales engineer and oftentimes the not too alert sales engineer are all involved in making forecasts of events and activities which are to occur in the future. These people have at hand certain basic information which assists them in arriving at their forecasts.

There are certain basic data relating to our Society which enable me to forecast a highly successful year ahead for ASLE. These data pertain to the present organizational status of the Society, including its sections, its joint technical committees, its industry lubrication councils and other plans for expansion of the Society's activities. To insure a great year ahead in our operation, the Society needs money, men and materials.

The chief sources of revenue for ASLE consist of membership dues, exhibits, advertising and industrial memberships. Plans have been laid for a rapid expansion of all of these sources of income. This expansion includes an increase in the editorial scope of *Lubrication Engineering,* thereby interesting a greater number of people in the field of lubrication engineering.

Members of the Society form the basic reason for the Society's existence. Our forecast indicates a substantial increase in membership during the year ahead. To accomplish this, we expect to acquaint more people with the Society's activities. This expansion in membership also requires the cooperative effort of everyone connected with the Society.

The third item required in our expansion forecast represents the plants, shops, factories and every piece of mechanical equipment requiring lubrication. A reduction in costs by organized lubrication will be of paramount interest to management.

While I have dedicated myself, as President of ASLE, towards the expansion and growth of the Society, I will need the active cooperation of every member. It is important that everyone work toward the common good of the Society.

A. B. Wilder,
President

"Since Cities Service Pacemaker 300 T- Injection molders operating perfectly."

Daniel A. Goetz, President and Charles R. Goetz, Dan's twin brother and Vice President of Stylette Plastics, agree on the value of a superior hydraulic oil. As Dan Goetz says, "we produce millions of 'giveaway' items every year. These items must be inexpensive . . . and to obtain the lowest cost possible we must produce in quantity and without expensive down-time on our injection molding machines. We had previously had trouble with our hydraulic oil and I think it was primarily due to the heat involved. We called in the Cities Service Lubrication Engineer and he switched us to Pacemaker 300 T. **Since using Pacemaker 300 T, our six injection molders have been operating perfectly."**

Pacemaker T is a premium hydraulic oil with excellent heat resistant properties and suitable for every type of hydraulic system. These oils have high viscosity index to minimize viscosity change with changing temperatures.

They are also fortified to resist oxidation and to give maximum protection against corrosion and rusting.

Contact your nearby Cities Service office for an experienced Lubrication Engineer to show you what advantages Pacemaker T can offer in your operation . . . or for further information, write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

The Goetz Twins, owners of Stylette Plastics went into the plastics business in Pittsburgh in 1952 on the recommendation of their professor at Duquesne University. They started with $1,500 and bought a nine ounce injection molding machine to make plastic tile.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

The **right lubricant** in the **right place** in the **right quantity** at the **right price**—those are the 5 R's of lubrication.

Efficient plant operation can be achieved only through the use of all of the 5 R's. For example, it is not enough to merely be using the right lubricant if the lubricant is not being applied in sufficient quantity.

Just as many visual aids are available for the teaching of the 3 R's (reading, writing, and arithmetic), so are many aids available to the lubrication engineer in teaching the 5 R's to management. Plant lubrication surveys, manufacturers' recommendation charts, and assistance in training plant lubrication personnel all point the way to the choice of the right lubricant. Keeping complete inventory and record systems facilitates the setting up of a preventive maintenance program—application of lubricant at the right place.

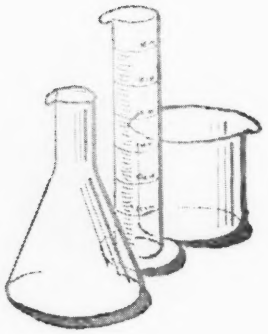
The right quantity of a lubricant can't be determined by a hit-or-miss method. Instead, many items must be considered before the proper amount can be determined for a particular application.

No clock chimes when the right time for lubrication comes around. Therefore, a good scheduling system must be set up—preferably a mechanized schedule.

The five articles which follow explain how the 5 R's of lubrication can make your plant function more efficiently.

The Right Lubricant:

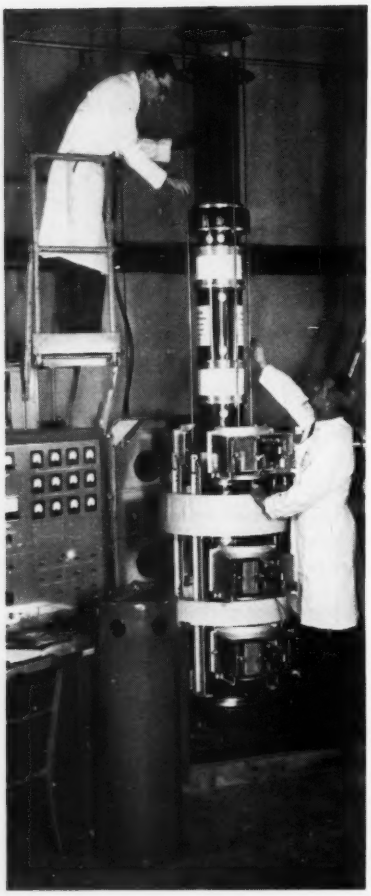
Marketing and Technical Service



The right lubricant supplied by a major oil company is a composite of basic, formulation, application research and technical service. Technical service rendered to the plant lubrication engineer comprises analysis of application, recommendation of proper lubricant and sound lubrication maintenance methods, and trouble shooting. Aids in accomplishing this service are plant lubrication surveys, manufacturers' recommendation charts, assistance in training plant lubrication personnel.

by H. Muller

Industrial Products Department, Shell Oil Company, New York



One of Eimac's super-power klystrons, the X626, being lowered into circuitry in the Eimac high voltage laboratory.

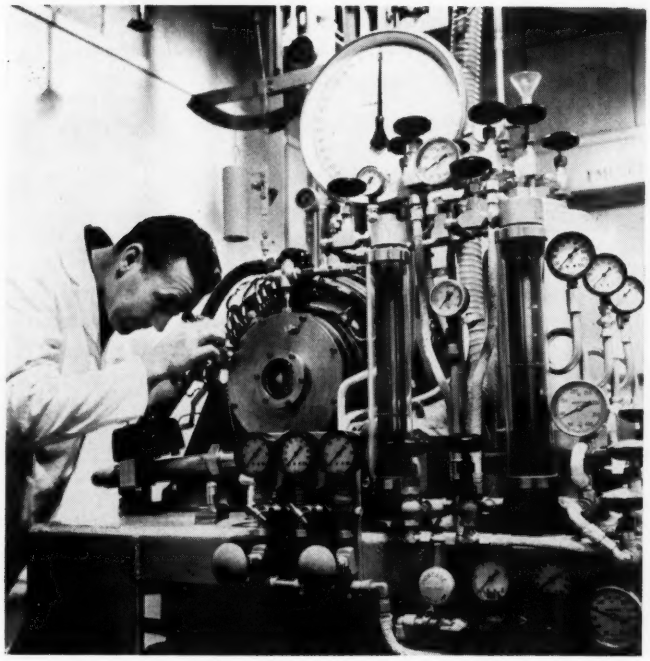
The lubricant supplier plays an important part in the 5 R's of lubrication. He is the originator of the product which, if it is the *right lubricant*, put in the *right place* at the *right time*, in the *right quantity*, and available at the *right price* can be expected to protect billions of dollars worth of equipment from early failure. How this is made possible becomes clear if we trace the development of the right lubricant from its cradle to its maximum usefulness. The concerted efforts of a qualified team produces the right lubricant as a result of

1. Basic Research
2. Formulation Research
3. Application Research
4. Technical Service
5. Selling

High-priced talent constantly is busy insuring the quality of the right lubricant. The scientist studies the underlying principles of lubrication, the molecular structure of the lubricant and the lubricated surfaces which the former is designed to keep apart in the interest of minimum friction and wear.

The product development chemist, supported by basic as well as application knowledge, builds the right lubricant from an ever-increasing number of different components. With lubrication requirements becoming more exacting in terms of load, speed, and temperature, today's lubricants present a delicate balance of carefully selected base stocks and additives which

Presented at the 13th Annual Meeting of the American Society of Lubrication Engineers held in Cleveland, April 1958.



A key problem in space flight—cutting down on the weight and size of machine parts—is being studied by this technician looking through a microscope at gears in a newly-developed high-speed gear testing machine. The machine, built by scientists at Shell Development Company's Emeryville, California research center, has shown that small, lightweight gears designed for about ten horsepower at 3000 rpm can transmit up to fifty times this power if they are run at extremely high speeds and properly lubricated. The Shell scientists have run gears at 30,000 rpm without injury to working surfaces in tests aimed at developing lubricants that will insure proper performance and protect metal under severe operating conditions.

must be fully compatible under a wide range of operating conditions. A great number of bench tests as closely correlating with actual service as possible are used to determine the merits as well as the limitations of the newly developed lubricant.

Then the application engineer takes hold of the newly born and exposes it to the rough conditions of controlled field testing in the various types of equipment which it must ultimately lubricate with a minimum of supervision. After the rough edges have been eliminated, which often involves passing the new product back and forth between the field test stage and the research laboratory, the technical service engineer cautiously introduces it to the market, spreading educational information on how to handle the product, where to use it and where not to use it, nursing it along for a while until it is finally released as a branded product to the sales force for unrestricted sales.

With this oversimplified outline of the birth and early youth of the right lubricant it will be appreciated that the supplier jealously protects the brand in which he has invested a great amount of thought, effort and money. That is why he opposes any specification and classification which could jeopardize his staff's development work by degrading the results of their arduous research to a low-priced commodity. Were it not for the unrestricted enthusiastic effort of the suppliers' product engineering teams, one wonders whether the top quality lubricants for the modern motor car, the turbojet, the nuclear power plant, and other extreme duty applications would be so readily available with every change in design. It should also be kept in mind that lubricants of a given formulation are often short-lived. The motor oil, the diesel engine oil, the gear oil, cutting oil, and hydraulic fluid of a decade ago illustrate how many drastic changes have occurred.

While lubricant formulations have to be adjusted to changing requirements on short notice, marketing methods have stabilized during the past decade. Technical service has developed to a modern marketing technique quite generally used as an aid in selling branded lubricants to the consumer.

Technical service or sales engineering is a relatively young branch of product marketing. Fifty years ago, technical service was in its infancy and selling by product brands was virtually nonexistent. With increasing rationalization in marketing, new methods were gradually introduced. Marketing research, sales development, technical service, and scientific pricing are a few of the newly established principles.

In lubricants marketing, one can either go the route of commodity selling or performance selling. Commodity selling, the least expensive way of disposing of lube oils, is generally confined to large-volume stock oil sales to blenders and compounders. Meeting a price and a loosely written specification is all that is needed.

Performance selling, on the other hand, usually is associated with selling a branded product for which specific performance claims can be made as the result of formulation and application research. Technical service is needed on the marketing side to bring to the customer's attention the maximum benefit which can be obtained from the product under the often severe

operating conditions to which it is subjected. The development and manufacture, as well as the sales and service effort invested in branded lubricants, justifiably result in increased cost. Premium products of this type appeal to the consuming industry because they carry with them the full backing of the supplier's research as well as application and technical service engineering staff. Lubrication with quality lubricants is increasingly recognized as a necessity in preventive maintenance, and the premium paid is considered a premium for production insurance. All major lubricant suppliers and many specialty houses render technical service for their branded lubricants. It establishes the supplier's reputation as a progressive marketer and instills customer confidence and loyalty. It also serves as a means toward brand protection. Lubricants must no longer be considered a minor nuisance, even though their annual purchase value in the industrial plant rarely amounts to more than one to two per cent of the total operating cost.

The author knows of no better way of illustrating the functions of technical service than quoting from a paper used in training courses for an oil company's industrial salesmen:

> "Technical service is the method of proving to the customer's engineering and maintenance staff, whether represented by the fleet owner's garage mechanic, the equipment manufacturer's design engineer or the industrial plant lubrication engineer, that the supplier is able and willing to assist them in solving their lubrication problems. Technical service is essentially made up of three phases, namely: (1) recommendation of the right lubricant for a given application; (2) recommendation of sound lubrication methods and maintenance practices, and (3) handling of product complaints and trouble shooting."

In order to recommend the right lubricant an analysis of the lubrication conditions has to be made along the following lines:

Engine or machine design
Normal or abnormal operating conditions
Mechanical condition of equipment
Lubrication system in use

Closer scrutiny reveals that the recommendation of the right lubricant embraces activities of a rather broad nature, such as:

a. Contact with service and engineering departments of equipment builders on developments in design affecting lubrication.
b. Preparation and presentation of technical information on product performance to consumers; in case of radically new products, also before technical societies.
c. Close cooperation with the plant lubrication engineers on all phases of lubricants applications and, where justified, the preparation of plant lubrication surveys.
d. Educational activities involving technical training of sales personnel and sometimes customer's lubrication staff.

The contact with equipment builders is important both from the angle of new lubricant developments as well as recommendation and approval charts covering existing lubricants.

Many manufacturers of machinery issue a list of approved lubricants and will void their warranty if their lubrication instructions are not followed. Lubricants Recommendation or Approval Charts prepared by the lubricant supplier and signed by the equipment builder are useful tools in insuring proper recommendation of the right lubricant by relatively untrained personnel, even in the jungles of Africa or Asia, a real service to the builder of equipment shipped abroad. The use of lubricants recommendation charts also is helpful in conducting plant surveys, especially in new plants where operators have not had an opportunity to build up background data on lubrication. In the interest of maximum usefulness lubricants recommendation charts should be accurate, complete, and up to date.

In recommending lubricants maintenance methods, the following factors, depending on the applications and conditions of the machine, should be considered:

Efficiency of lubrication system
Cleanliness of lubrication system
Purification of lubricant during service
Lubricants storage and dispensing facilities
Maintenance records
Drain intervals

While positive recommendations on the foregoing subjects are generally welcomed by the customer, it is good practice to cooperate whenever possible with the equipment builders' representative when changes in machine design are involved.

It is needless to elaborate on the necessity for a speedy and thorough investigation of complaints. Nothing is more aggravating to the customer than machinery breakdown. A properly settled complaint builds customer loyalty just as any other form of technical service. In handling complaints the product application engineer and often the research chemist are helpful if product quality is under suspicion.

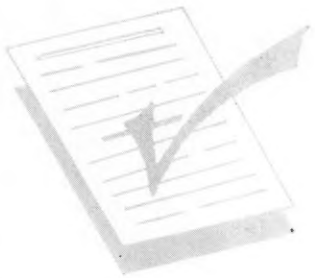
The area of technical service covers all consumers who operate engines and machines for profit; they appreciate technical lubrication advice which helps them maintain the productivity of their equipment. Specifically, this applies to most manufacturing plants, electric utilities, and the many branches of transportation, including the commercial automotive fleets, railroads, air transport and shipping.

The key personnel in industry who benefit from this technical service include the lubrication engineer in the manufacturing plant or utility and the vehicle main-

(*Cont. on p. 216*)

The Right Place:

Plant Practices in Lubrication and Preventive Maintenance



Regular lubrication and inspection has made it possible to keep all the machines in a particular plant in excellent operating condition. A similar program, if carefully planned, can be executed by any company and can result in dollar savings as well as increased efficiency.

by R. G. Grothus

Bell & Howell Corp., Chicago, Ill.

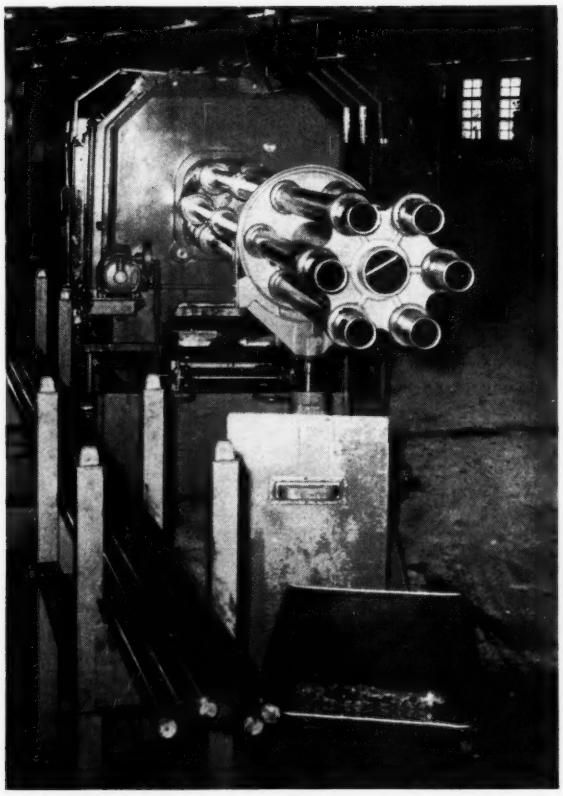


Fig. 1. Multiple spindle New Britain screw machine tools aluminum rod stock for camera and projector lens hoods at Bell & Howell in company's screw machine department. Systematic oiling in preventative maintenance program reduces down-time on banks of these machines.

In the author's plant there are approximately 3,800 persons, 125 of them maintenance employees. The maintenance operation, headed by a building superintendent, is divided into eight departments, each supervised by a foreman. Three individuals in the maintenance organization are responsible for the plant lubrication program. Their duties are as follows:

1. Assistant superintendent, building maintenance—responsible for planning preventive maintenance inspections, scheduling, insurance inspections, budgets, oiler and special assignments.
2. Machine maintenance foreman—responsible for machinists, machinists' helpers and machine lubrication men.
3. Electrical foreman—responsible for electricians and electrician helpers.

Many plants have started a preventive maintenance program, but after a few months have given it up because they could not see any results. But the plant which sets a definite step by step course will find that a preventive maintenance program pays big dividends.

COMPLETE INVENTORY AND RECORD SYSTEM

In order to set up a good program, a complete inventory must first be made of all equipment in the plant. This can be done by room, department, floor, area or building. As this information is acquired, it must be entered on some type of history record card, such as Fig. 1. In the author's plant, this is referred to as a preventive maintenance card.

In the upper right-hand corner of the preventive maintenance card is shown the inventory number of

Presented at the 13th Annual Meeting of the American Society of Lubrication Engineers held in Cleveland, April 1958.

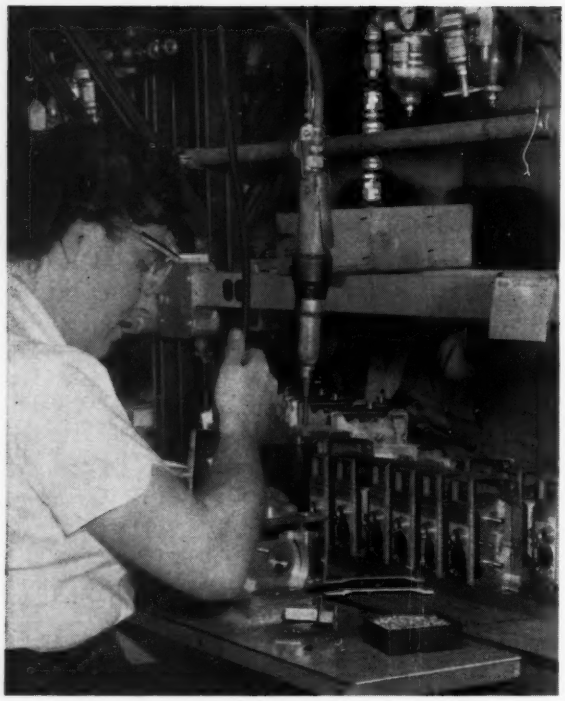


Fig. 2. Air driven screw drivers at right of operator are self-oiled from air pressure oilers suspended on line above work area. This conveyorized assembly line is used for cameras and projectors.

the equipment is the space labeled "equipment number." This inventory number is assigned to a piece of equipment when purchased and is used throughout the life of the machine for maintenance and depreciation value. Various details of information pertinent to the equipment are recorded in their proper places on the card. In the "inspection schedule" section of the card the week of the year that the inspection should be performed is shown. It should be noted that five trades have been listed—carpenter, mechanic, electrician, tinsmith and stationary engineer. This is because the maintenance department not only maintains manufacturing equipment, but also maintains all the buildings, facility operating equipment, and 68 acres of grounds. This schedule is used to check off (through experience of a two-year trial period) when and how often an inspection should be performed by one of these trades. The "inspection performed" part of the schedule is used to specify the year and also the week that inspection should be made. At no time is an inspection schedule delayed more than two weeks.

On the back of the preventive maintenance history card (Fig. 2), a record is kept of "repair and maintenance history." This includes a description of the work, what was wrong, what is to be done, what has been done, the date it occurred, etc.

SELECTION OF LUBRICANTS

After the above information has been assembled,

PREVENTIVE MAINTENANCE

EQUIPMENT NO _____

DESCRIPTION _____

MANUFACTURER _____

REPLACEMENT PARTS SUPPLIER _____

SPECIFICATIONS _____

ACCESSORIES _____

LUBRICATION _____

REMARKS _____

LOCATION			
BLDG			
FLOOR			
DEPT			
ROOM			
AREA			

DATE PURCHASED _____

B. & H. P.O. NO _____

OTHER NUMBER _____

COST _____

INSTALLATION COST _____

WEIGHT _____

FLOOR AREA _____

UTILITIES REQUIRED

☐ AIR ☐ GAS
☐ WATER ☐ VENT
☐ STEAM ☐ ELECT
☐ DRAIN _____
☐ VACUUM _____

REFERENCE FILE NO. _____

INSPECTION SCHEDULE

WEEK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
CARPENTER (C)																																																				
MECHANICAL (M)																																																				
ELECTRICAL (E)																																																			
TINSMITH (T)																																																				
ENGINEER (B)																																																			

INSPECTION PERFORMED

WEEK	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52

Fig. 1. Preventive maintenance card.

REPAIR AND MAINTENANCE HISTORY

DESCRIPTION OF WORK	DATE MO.	DAY	YR.	W.O. NO.	LABOR HOURS	LABOR COST	MATERIAL COST	TOTAL COST

Fig. 2. Back side of preventive maintenance card.

B & H SPECIFICATION
1176
Rev. A
DATE OF ISSUE 2/13/58

SUBJECT:
GENERAL PURPOSE GREASE

SUPERSEDING
B & H SPEC. NO. 1176
DATE 12/31/51

1. SCOPE

This specification covers a material to be used as a lubricant for camera and projector mechanisms, exclusive of bearings. This material is also intended for general plant maintenance.

General Material Specification No. 1340 shall be considered a part of this specification.

2. REQUIREMENTS

A. Chemical

1. Copper Strip Corrosion, 3 hrs. at 212°F	Negative
2. Oxidation Stability	5 psi max.

B. Physical

1. Oil Content	90% Min.
2. Viscosity of oil content, 100°F, S.U.S.	2100-2300
3. Viscosity Index	50 Min.
4. Penetration (Cone)	310-340
5. Dropping Point	None
6. Water	None
7. Fillers	None
8. Color	8 Max.

3. TEST METHODS

Copper Strip Corrosion	ASTM D-130
Oxygen Stability	ASTM D-942
Viscosity of Oil Content, Saybolt	ASTM D-88
Viscosity Index	ASTM D-567
Penetration	ASTM D-217
Dropping Point	ASTM D-566
Oil Content	ASTM D-128
Water	ASTM D-128
Fillers	ASTM D-128
Color	ASTM D-155

WRITTEN BY MS DEPT. 6814
APVD. BY
ISSUED BY FG DEPT. 6809

DRAWING DESIGNATION
General Purpose Grease
B & H SPEC. NO. 1176 - Rev. A

SHEET 1 OF 1

Fig. 3. Specification sheet.

groupings of equipment can be made according to the viscosity and physical properties of the lubricants required. From this can be determined how many different ranges of viscosity and lubricants are needed and the total quantity of each. With this information at hand, a look should be taken at available lubricants. It will be found that even though groupings are made according to viscosity and physical properties, it is possible to eliminate many of these groups because of the overlapping in viscosity ranges which does not alter the physical properties. After the different types of lubricants to fit each group have been found, the physical inspection requirements for each type of lubricant can be set down.

On the company specification sheet (Fig. 3), the new specification number assigned to the particular product which will be set up for use in the company is shown together with the indicated additional information.

The test mentioned on the form requires that any lubricant purchased according to this specification be inspected when received by the company to determine whether or not it meets the required standards. This form assigns a number to the specification so that it can be identified readily.

The end results of investigating the different products are compiled on Fig. 4, used by the foreman and lubrication men in the maintenance department. It guides the buyer in the purchasing department in procuring lubricants from suppliers.

Maintenance Code	B&H Spec. No.	Use	Example	Spec. Viscosity	Approved Supplier	Lubricant Approved	Temp.
#1	172B	General Purpose Lubricating Oil	Circulating Systems, Bath Oiling Systems, Splash Oiled Mechanisms, Gears & Hand Oiling on Mach. Tools	275-325 S.U.S. @ 100° F.			
#2	364	Motor Oil	Internal Combusion Engines Machine Tools, etc.	S.A.F. 30			
#3	174B	Heavy Spindle Oil	Machine Tool Spindles with speeds below 5000 R.P.M.	95-115 S.U.S. @ 100° F.			

Fig. 4. Lubrication reference sheet.

SETTING UP CONTROLS OF LUBRICANTS ON NEW MACHINERY

The card labeled "Installation Data on New Machines" (Fig. 5) is used on any new machine brought into the company. This card is initiated by a maintenance clerk, who indicates at the top the department where the machine is to be located, company inventory number, manufacturer's name, type of machine, etc. The card is then routed as indicated.

The machine maintenance foreman then makes up the periodic lubrication record and the lubrication chart, seen in Figs. 6 and 8. He then makes the run-in on the machine. The individual foreman's signature is required on each routing to indicate that the work is complete and, after all signatures are attached, the machine is then ready for production engineering.

After the lubricating man has performed the work indicated in Figure 6, he fills in the reverse side of the periodic lubrication record, Fig. 7.

Fig. 8 shows the lubrication chart which is attached in plastic inserts to each machine throughout the plant. As will be noted, symbols plus a color are used. The reason for this code is that 27 per cent of the United States' population is color blind. In addition, the name of the color has been added. Even with the color code and number system, oilers have been

INSTALLATION DATA ON NEW MACHINES

Dept. B&H No.

Mach. Center# Mach.Serial#

Mach. Mfr. Type of Mach.

Routing

1. Electrician Foreman Dept. 841 — Machine Wired ☐ Fuses Not Installed ☐ Signed

2. Night Supt. Dept. 841 — Motor Lubricated ☐ Machine Lubricated ☐
Mach. Make
Serial No.
Type
H.P.
Frame
Phase
R.P.M.
Lub. No. Lub. Period
Signed

3. Machine Maintenance Dept. 110 Bldg. #9 — Machine Lubricated ☐ Installation Complete ☐ Signed

4. Electrician Foreman Dept. 841 — Fuses Installed ☐ Machine Ready For Production Engineering ☐ Signed

5. Maintenance Clerk Dept. 841 — Motor Placed on Automatic Motor Lubrication Schedule ☐

FILE

Fig. 5. Installation data on new machines.

Date Due	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
Name of Machine								Bearings Type-				
Ser. #			B & H #					Belts-				
M.C. #			DEPT. #									

Op'n. No.	PART	LUBRICANT	LUB.NO.	AMT.	FREQ.

Fig. 6. Periodic lubrication record.

PERIODIC LUBRICATION RECORD

Op'n No.	Next Due	Done	By	Op'n No.	Next Due	Done	By	Op'n No.	Next Due	Done	By	Op'n No.	Next Due	Done	By

Fig. 7. Back side of periodic lubrication record.

LUBRICATION CHART

MACHINE #008 Cincinnati Mill M.C.

SYMBOL	LUB.#	PERIOD	INSTRUCTIONS	RESPONSIBILITY
ORANGE	1	DAILY	CHECK PRESSURE 300 to 350 LBS.	DEPT.
BLUE	3			
GREEN	4			
WHITE	6			
RED	14			
WHITE	7	6 MONTHS	DRAIN-FLUSH RESERVOIR CLEAN OR CHANGE FILTER-FILL TO GAUGE	MACH. MAIN.
BLACK	8			
BLACK	13			
BROWN	A	6 MONTHS	MOTOR	ELEC. MAIN.
BROWN	B			
BROWN	C			

Fig. 8. Lubrication chart.

MOTOR LUBRICATION ROUTE SHEET

SHEET 1 OF 6
WEEK 20
FREQ.:
M-4 Q-7 S-20 A-20

BLDG. NO.	ROOM NO.	DEPT. NO.	MACHINE CENTER	INVENTORY NO.	MACHINE DESCRIPTION	MOTOR SER. NO.	LUB. NO.	FREQ. CODE	DATE LUB.
1	320A	6810	3211-1	2679	South Bend Lathe	4780240	7	M-4	
1	322	6807	3800-2	658	Stark Benth Lathe	7267988	7	M-4	
1	322	6807	3210-3	2222	Logan Lathe	458069	7	M-4	
1	322	6807	7800-1	2164	Buehler Lapping Machine	X2-8	A	S-20	
1	322	6807	7800-1	2164	Buehler Lapping Machine	X1	A	S-20	
1	322	6807	7800-1	2164	Buehler Lapping Machine	PG2022	A	S-20	
1	322	6807	8490-1	2233	Stewart Furnace	16293	5	A-20	

Fig. 9. Motor lubrication route sheet.

known to make mistakes and put the wrong oil or grease in a machine. One sure method of minimizing errors is for the oilers to attend a lubrication course. An added expense at first, it pays off in the long run.

AUTOMATIC LUBRICATION

The time is fast coming when all new machines will be built with just one place to put grease or oil. Five years ago, a punch press had to be oiled by hand three times a day. Today a press comes from the factory equipped with automatic oilers which have to be filled only twice a week. This is one of the many new and better ways of lubricating machines.

The second column in Fig. 8, headed "lubricants" indicates lubricant number (1, 3, etc.) or grease letter (a, b, or c). The third column, "period", specifies the frequency of lubrication—daily, biweekly, semi-annually, annually or whatever the case may be. The fourth column covers instructions, such as checking the pressure gage daily. The last column indicates whether the responsibility is that of the department in which the machine is located, the machine maintenance department or the electrical maintenance department.

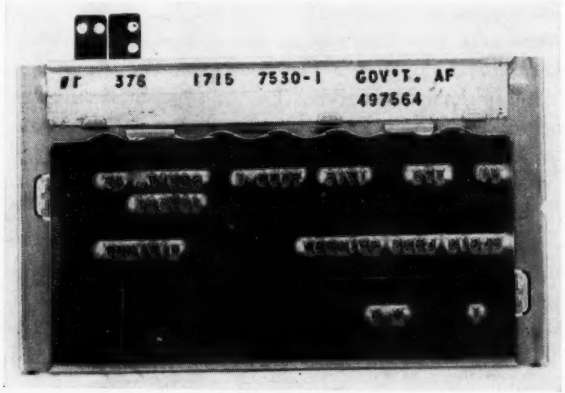


Fig. 10. Addressing plate.

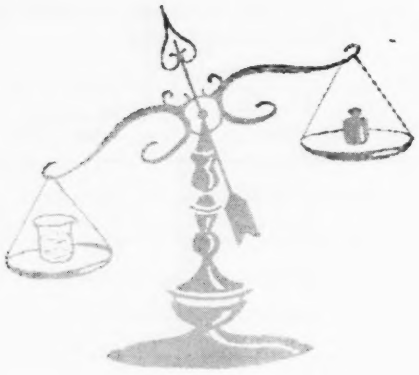
PREDETERMINED AUTOMATIC ROUTING SYSTEM

Fig. 9 is an example of a motor lubrication route sheet, the actual work order for the lubrication men. It lists in a geographical route sequence those motors scheduled for lubrication during the week specified on the sheet. (Weeks are designated by their number within the calendar year.)

For purposes of designating location, the sheet lists the building number, room number, and/or department number. The specific motor to be lubricated is designated by indicating the machine center number, inventory number, and description of the machine on which the motor is located and the serial number of the motor itself.

The lubrication number is the code number of the lubricant(s) to be used. The frequency code indicates the frequency of lubrication for the motor (*M* for monthly, *Q* for quarterly, *S* for semi-annually and *A* for annually) and the numbers of the weeks within its frequency cycle that the motor is scheduled for lubrication (1 to 4 for monthly, 1 to 13 for quarterly, 1 to 26 for semi-annually, and 1 to 52 for annually. For example, motors coded *M*-4 would be scheduled for lubrication on the weeks of the year numbered 4, 8, 12, 16, 20, etc.; those coded *Q*-7 on weeks 7, 20, 33, and 46; those coded *S*-20 on weeks 20 and 46.

Each week the motor lubrication route sheet for that week is prepared from a master file of addressing plates (such as that shown in Fig. 10), each containing the information to be printed on the route sheet (building number, room number, etc.). The plates in this master file are arranged in geographical sequence and each plate is tabbed to indicate the frequency code embossed on the plate. This tabbing is accomplished by means of two metal tabs inserted in the top of each plate. The positions of the tabs in the plate indicate the frequency of lubrication. The various positions of the two holes in each tab represent a digit from 0 to 9 and, therefore, indicate the digits of the week number within the frequency cycle. (*Cont. on p. 215*)



The Right Quantity

by P. J. Galbreath
Tennessee Eastman
Div. of Eastman Kodak Co., Kingsport, Tenn.

The right quantity is generally defined as the use of proper lubricant in amounts as required. This wide-ranging definition leads to many practices and plenty of latitude to do as one sees fit. This article covers some of the items to be considered in establishing the right quantity, namely

1. **Product contamination.**
2. **Fire hazards.**
3. **Housekeeping and safety.**
4. **Labor in applying lubricants.**
5. **Over-lubrication of ball and roller bearings.**
6. **Attaining right quantity:**
   - **(a) Manufacturer's recommendations with suitable modifications.**
   - **(b) Based on experience.**
   - **(c) Arbitrary scheduling and modifying.**

A hero is said to be a person who has the fortune to be in the right place, at the right time, doing the right thing. A lubricant must do all these things, and must be in the right quantity.

The right quantity has been defined as using the proper lubricant in amounts as required. This nebulous statement leads to many practices and plenty of latitude in developing lubrication procedures.

In nature, the framework of animals is composed of many joints which are so well lubricated that they operate for an entire lifetime with an effectiveness that has never been approached in man-made mechanisms. This is due to the suitability of the sealed-in lubricant provided which is kept pure and, unless disease intervenes, is not allowed to become contaminated. Nature furnishes the lubricant needed to prevent the hair on animals from cracking and breaking due to wear, thus providing protection and adornment. She does not use the same lubricant for all parts of the body, but wisely selects and properly applies that which is suitable for each condition of use.

In machines made of parts which move upon each other, lubrication is a necessity. Otherwise, operation could not continue without destruction of the parts. The quantity of lubrication required is entirely dependent upon the design of the machine.

Presented at the 13th Annual Meeting of the American Society of Lubrication Engineers held in Cleveland, April 1958.

PRODUCT CONTAMINATION

If the quantity of lubricant is not carefully controlled, product contamination can become a problem in many industries. In the textile industry, for example, if spindles and roll shafts permit lubricant to drip on the product, whether due to over-lubrication or improper seals, costly and unnecessary losses result. The chemical, pharmaceutical, and food industries must guard against product contamination. In general, a great deal of effort is expended in the original design of this type of equipment to allow for some variations in lubrication methods. If the equipment is over-lubricated and the design is not adequate to cope with it, contamination may result. If, on the other hand, under-lubrication occurs, metallic particles from the abraded parts may enter the system and cause contamination. In pigment or color work, lubrication and its system must be exact to prevent loss of product, sometimes not detectable until a future time when color matching is required.

FIRE HAZARDS

In high temperature application, fire hazards are involved. A barrier, even a small one, to separate high temperature parts and lubricants is a wise precaution. If the system is so constructed, malfunction from excess sprayed lubricant, leaking oil, or dripping grease is minimized. Such malfunction may occur on hot roll applications, on hot engine parts, or on a leaking

reservoir, located adjacent to high temperature parts. However, if lubrication is inadequate, high temperature can be generated within the bearing system and can create a fire hazard within itself. Bearings, with their lubricant chambers, should be separated so that large volumes of lubricant at any one location are eliminated, and thus prevent a fire from spreading. Here again, with good design and the proper application of glands, and seals, and strict adherence to minimum required lubrication, high temperature equipment can be operated with a considerable margin of safety.

HOUSEKEEPING AND SAFETY

Housekeeping and safety are involved where excessive quantities of lubricants are used. An example of this might be an overfilled hydraulic system and consequent leakage to a well-used floor area. A potential fire hazard, this is hazardous to personnel. It has been said that "Any lubricant you can see is not doing a job." Proper scheduling and good arrangement of lubricant dispensing equipment can be a step toward good housekeeping and safety. A mess should not be tolerated. It is essential to keep the lubricant where it belongs. Drip pans and catch basins have their place, but they often present a problem when not emptied and maintained in good condition. A better procedure is to use a regulated and specified amount of lubricant to eliminate practically all excess. If confining systems including seals, glands, labyrinths and gaskets are in good operating condition, housekeeping becomes less of a problem.

LABOR IN APPLYING LUBRICANTS

The amount of labor required to apply lubricants will vary in different industries, but often amounts to 10 to 15 times the cost of the lubricant. This may seem high, but consider for a moment the factors involved. It is necessary to have an adequate program, or schedule, of lubrication. This will determine the personnel required to complete these schedules in a prescribed time. Lubricating facilities, whether modern or antiquated, will determine to some measure the time each lubrication man spends completing these schedules. Another factor might well be the type of equipment being lubricated. The fields of lubrication are classified as follows: farm, marine, and automotive machinery; steam, diesel, and electric railways; heavy machinery such as steel mills; medium-weight machinery, used in general manufacturing plants; and light-weight machinery such as used by textile mills, which probably constitute the best-lubricated industrial machinery. Of course, the ability and skill of personnel and supervision will help determine the efficiency and cost of the program.

OVER-LUBRICATION OF BEARINGS

Many years ago, when plain bearings were used almost exclusively, over-lubrication was in order. Today ball and roller bearings require a limited amount, packed properly, and then checked at periodic intervals. Over-lubrication of ball and roller bearings leads to excessive churning of the lubricant with heat, foaming, leakage, and deterioration of the lubricant. In general, with grease, the housing should be filled not over one-half full; with oil, the level of oil should never be above the center of the lowest ball. There are exceptions to every general rule. If there is doubt as to the amount of lubricant in any unit, whether it be new or original equipment, it is wise to flush the bearings and repack or refill to the proper amount with the correct lubricant for the application.

MANUFACTURING RECOMMENDATIONS

The right quantity can be determined by several methods. Manufacturers' recommendations suitably modified to meet specific demands is one example. For instance, if a machine has a wide range of speeds of operation, it might be necessary to modify lubrication procedures where the equipment is operating at one end of the range. Again, if a new factor, such as heat, has been added to the operation, it might be necessary to change lubricants, change seal material and quantity, perhaps by adjusting the time interval between relubrication periods. If the equipment is in a dusty atmosphere rather than an air-conditioned area as recommended by the manufacturer, the original recommendation is obviously affected. Also if the machine, after being placed in operation, is found to operate at double the rated capacity and speed, the manufacturer's recommendations should be reviewed and modified.

EXPERIENCE

Experience is by far the most practical yardstick to use in determining quantity requirements. If additional machines are added to an existing group of similar machines, experience will play a large part in determining the exact quantities of lubricant to be used for the new equipment. Specific conditions of operation and environment found in the user's plant are often different than expected by the equipment manufacturer—this is another advantage where experience on the part of the user is beneficial. Theory is fine, but it must be tempered with actual experience. A new design as yet untried by the manufacturer in a production application should be reviewed carefully for lubrication on the basis of experience on similar equipment in a particular plant.

ARBITRARY SCHEDULING

Arbitrary scheduling and later modification of the schedule based on results attained is a practical approach to the problem. Maintenance cost could reflect the need for a change in lubricating methods and scheduling. Bearing failures are expensive, particularly in continuous duty equipment. Seal problems, leakage, and general housekeeping all can be improved by proper scheduling and the use of correct quantities of lubricants. To know "how much is enough" is part of the science of lubrication.

The Right Time:

Mechanized Scheduling of Lubrication

by C. R. Galbreath
Decatur Plant Engineer Caterpillar Tractor Co., Decatur, Ill.

To show how mechanized scheduling of lubrication can be employed as part of a lubrication program, a medium-sized manufacturing plant of 1,500 machines was studied. The machines represent considerable capital investment. They must be protected by proper lubrication and kept running by proper lubrication. The right lubricant must get to the right place at the right time, in the right amount.

The scheduling of lubrication in a plant of this size becomes quite a task because of the thousands of applications which must be made weekly. Logically then, the scheduling falls into an area where machine scheduling is almost a must because of the quantities involved. There are hundreds of machines, thousands of application points, and a variety of lubricants and frequencies to be considered. Most plants have machine accounting systems which can be made available for this task of machine scheduling.

Machine scheduling will have fewer mistakes than manual scheduling. Personnel problems with scheduling clerks that foul up a manual system are eliminated.

In setting up the machine scheduling of lubrication, several preliminary steps should be taken. Lubricants should be standardized and kept to the absolute minimum. A color code or number code should be set up so that the problem of identification is made as simple as possible for the lubricator. As an added help, standards should be set on terminology so that the lubricator knows what is being talked about. The various lubricating devices and fittings should be identified. These should be standardized upon and kept to a minimum.

Each machine and piece of equipment should be studied individually as to its lubrication. A card should then be made out showing what these are in detail, using the codes and terminology that have already been established. These cards should show the following:

1. Area and location
2. Machine number
3. Machine description
4. Lubrication point number
5. Part to be lubricated
6. Device to be lubricated and location
7. Recommended lubricant
8. Frequency of lubrication
9. Week of year lubrication is scheduled.

At the time the individual machines are studied, consideration should be given to the installation of central lubrication systems where these are found to be practical and economical.

Lubrication routes should be set up with the eight-hour and daily frequencies in mind. These can be put on the machine scheduling setup, however, they need only be printed occasionally as a check or when changes are made. Since the eight-hour and daily frequencies are best set up on a location sequence by areas, it is quite easy to schedule the other frequencies and divide them between shifts. The machine scheduling of all frequencies other than the eight-hour and daily can be done on a weekly basis. This allows the lubricator a certain amount of flexibility in working this schedule in with his routine program.

Finally, the man doing the work of lubrication should be given the proper tools and instructions to do his job properly. He should at all times have a copy of the lubrication codes available. He should have a copy of the lubrication terminology with pictures, if necessary. The proper tools should include a lubrication cart with a generous supply of the oils and greases

(*Cont. on p. 216*)

Presented at the 13th Annual Meeting of the American Society of Lubrication Engineers held in Cleveland, April 1958.

The Right Lubricant at the Right Price

by G. L. Duke
Westinghouse Electric Corp., Atomic Power Dept., Pittsburgh, Pa.

Spending other people's money is a glamorous task, but it also has its responsibilities. The purchasing man must obtain maximum value for every dollar spent. The purchase of petroleum products is not one of the more glamorous types of materials handled by an industrial buyer. The reasons are obvious. First, unless the petroleum product is going into the end-product that the company is manufacturing, the volume of lubricants, compared to other items being purchased, does not rank high on a dollar basis. Second, there are probably more experts and personal preferences in the area of lubrication than in any other single thing to be purchased with the possible exception of drills and other cutting tools. Third, the petroleum industry has developed its sales techniques and probably allocates as high a percentages of its total dollar sales to sales effort as any product sold industrially. Fourth, too frequently, the buyer is faced with a lack of objective evaluation, and must make his decision with little or no factual information to back up this decision. Fifth, lubricating oils still have an aura of black-magic and secret formulas, and the average buyer finds it extremely difficult to strip away the fanfare and get down to facts. And finally, it is routine to assign plant lubrication buying to the man who buys maintenance, repair and operating supplies, and he is often the least experienced and probably the last buyer who entered the department.

Lubricants can be a challenge and can be a very interesting assignment. This can only be true, however, if the buyer's superior and other management personnel are interested in the problem and can see the value of buying machine life, rather than on a price per gallon basis. Also to make this an interesting project, the buyer must have complete cooperation from the shop people and his engineers, as well as from his boss. Once he has this backing, then he must have a plan. The purpose of this article is not to discuss which way a purchasing program is carried out, but to emphasize that the program be carefully planned and that the plan be followed through.

Presented at the 13th Annual Meeting of the American Society of Lubrication Engineers held in Cleveland, April 1958.

METHODS OF PURCHASING

There is no *best* way to buy lubricants, but there are several satisfactory ways. The method that is used depends on the situations which exist with the individual buyer and the facilities which he has at his disposal. His method also depends on the size of his company, the complexity of the problem, the support that he gets from upper management, and the total dollars involved in his lubricant requirements. For example: a research organization, such as the one with which the author is now connected, having only a model shop, obviously has a different requirement and a different approach to procurement of lubricants than did the one with which the author was formerly associated, which built aviation gas turbine equipment and had three million square feet of floor space literally jam-packed with machine tools.

Some of the methods being used or which could be used by a buyer in purchasing lubricants are as follows:

1. Too frequently the method of *hit-or-miss buying* according to a manufacturing engineer or shop foreman's preference is standard operating practice. Perhaps this is supplemented by the buyer's experience or personal preference. When lubricants are bought by this method, the storeroom becomes a gathering place for drums of every color in the rainbow. Failure of equipment is risked, not only because the lubricant purchased for a particular piece of equipment may not have been the correct one, but also because of the chance of getting the wrong lubricant in the machine.

Costs are bound to be higher since purchases are made in small quantities. A great deal of repetitive ordering of single drums or even less than drum quantities is the usual result of this method. The storeroom runs a high dollar inventory. Probably every few years, many of the oils are sent from storeroom to scrap heap. Also when buying a brand on a hit or miss basis, there is little room to negotiate. The salesman has a catalog price, and he has no incentive and cannot deviate legally from this catalog price for quantities used.

2. Another method of procurement is that of *cataloging recommendations* of the machinery manufacturers and stocking according to these recommendations. The buyer will buy as many different brands as he has recommendations. As is known, there is a continuing program with certain major oil companies to get their lubricant nameplate on original equipment. This undoubtedly helps them sell oil, but it surely confuses the maintenance people and the lubricant buyer. Here again, the buyer is faced with high inventory and high dollar costs for lubricants. He has an extremely difficult service job if different oil companies have been successful in having their nameplates affixed to the machine tools in the plant.
3. Most oil companies are willing and able to *survey the entire facilities of a buyer's plant* and to come up with a complete analysis of the requirements by brand name of their particular company's products. This approach is an improvement over the first two methods. This method is expensive for the oil companies and the average buyer will not be satisfied until he has two or more companies making the survey. Assuming that the sales expense of these surveys must be absorbed, it certainly must be reflected somewhere in the price of the product. There is also the danger that the company making the survey will not recommend the minimum requirements for the job, but will try to recommend one of their more superior oils to cut down the number of oils required, thereby paying premiums in some areas to hold down to the minimum number of oils.

   Requirements are specified by brand, and there is no assurance that the specifications for a particular brand will not change from time to time as the technology of the oil business changes. Of the methods mentioned so far, this is the best planned program for a buyer, particularly if he does not have the facilities available to develop his own specifications for his own requirements. If he commits himself to a survey by two or more companies, then in cooperation with his maintenance people, he should award one company the business for at least a year. If the service has been satisfactory and maintenance costs have been reasonable, it may be that he will want to continue indefinitely with that one supplier. If he is not satisfied at the end of the year, then he must re-evaluate the situation and perhaps give one of the other companies who made the survey an opportunity to see whether they can do a better job.
4. About the only way that the buyer really can develop a competitive situation is to *create some standards* by which he can evaluate all the claims and counter-claims of the salesmen who call upon him. The best way to do this is by developing a set of specifications. This does not mean that his engineering personnel should dream up their own specifications, but they should develop a broad band of specifications into which products already being manufactured can be slotted. Some of the experiences developed from 1949 to 1952 when the author served as a member of the Lubrication Committee of the author's company are pertinent to the subject. This committee was made up of materials engineers, purchasing personnel, manufacturing engineers, and plant maintenance people. It was their objective to (1) reduce lubricant costs, (2) reduce equipment maintenance costs, (3) increase the reliability of apparatus manufactured by the company, and (4) improve relations with suppliers.

A PROBLEM RESOLVED

As a starting point, an analysis was made of the oils and greases being used. It was found that approximately $400,000 a year was being spent for lubrication of plant production equipment. This $400,000 expenditure involved procurement of over 500 brands and specifications at prices varying on a single item from $.24 to $.50 a gallon.

The method of operation was simple. The materials engineering personnel developed tentative specifications which would cover a range of lubricating requirements. Tentative specifications were issued to all vendors for their comments. They were asked specifically whether they had a product on the market which could qualify for each particular specification. After this exchange of correspondence, broad specifications were developed which included products currently in production by most of the suppliers.

These products were then approved, and the approved list was distributed to all operating divisions. It should be noted, however, that procurement was by specification. This was to protect the company against a product specification change by a particular brand name.

This work was carried out by the department handling materials engineering, and one man was assigned full time to the project. This man served as the engineering coordinator. His functions included (1) intensive study of company machine tool lubrication requirements, (2) a study of the types of lubricants currently in use, (3) a study of government specifications, (4) development of a broad band of specifications to satisfy machine tool and production requirements, (5) supervision of analyses and testing of

samples submitted by oil companies, (6) coordination of lubrication engineering personnel with program at divisional level, and (7) provision of technical assistance wherever required, both to manufacturing locations and to vendors' representatives.

The magnitude of this project should not be underestimated from an engineering viewpoint. A substantial sum, measured in thousands of dollars, was appropriated to underwrite the project. The results indicate that the investment was justified.

Some interesting accomplishments accrued through use of this method of obtaining lubricants are of interest. In 1951, 36 per cent of the purchased oils were in two specifications with dash numbers to indicate the various viscosities, and a yearly savings of $32,000 had developed. Total expenditure for the previous year was $400,000, so a savings of nearly 10 per cent resulted.

By 1952, 97 per cent of the main lubricants were covered by approximately 30 different oils—a significant reduction from the 500 formerly used. These specifications were also used as a basis for recommendations to customers in many applications, and by January 1953, 326,000 gallons of lubricating oils were under contract on a program basis. The total savings had approached $50,000 per year.

During the period from 1951 thru 1953, total requirements were accumulated and bids were obtained for the total company requirements for a given period. Allocations were made on a regional basis to the low bidder. Subsequent to that period, responsibility for negotiations was referred back to the divisional purchasing agents, and they have since been operating on these broad specifications. As a summary of the results of this program, the following statement is quoted from the annual report of the Lubrication Committee dated February 1, 1954:

> "The various viscosity grades covered by the five major oil specifications, now in effect, cover the requirements of most of the apparatus manufactured by the company. Oils purchased under these specifications have the following advantages: (1) the specifications have been tested by nationwide use for the lubrication of plant equipment. We now have experience gained by the use of millions of gallons of these oils in every conceivable type of apparatus installed in company plants. (2) Oils purchased under these specifications comply with modern refinery practice. This assures long time stability of products available. (3) The approval and quality control testing of oils received against these specifications is an almost positive assurance that any undesirable variation in product will be detected. (4) Products covered by these specifications are not restricted by refiners market areas, but are available on a nationwide basis and in all industrial countries abroad. (5) Oils obtained under these specifications can be interchanged with no restrictions as to source or proportion. (6) Use of these oils is a guarantee against sudden fluctuations in product type or designation. Such changes occur regularly with oils specified as trade names."

Purchasing, some years ago, had an item concerning a large company's experience in procuring oils on a basis similar to the above. That company's survey showed over 700 different lubricants being used, whereas not more than 75 should have been sufficient. Their approach to specifications was somewhat different than the one described above, for they established their goal by approving and cataloging specifications of existing lubricants suitable for their requirements.

For a large company, major savings can be demonstrated not only in the cost of the lubricants, but in the cost of maintenance by a planned program. When this program is worked on a cooperative basis with manufacturing engineering, lubrication engineering, purchasing and the vendor all on the same team, emphasis must be given to the fact that the vendors must be willing to cooperate so that this type of program be a success.

This may not be the right approach in all cases. There are many companies which cannot afford or cannot justify the expenditures for the broad approach described herein. In any event, the buyer cannot treat lubricants as an insignificant item. He must look at the total requirements and tailor his plan to satisfy his specific need.

The Right Place

(*Cont. from p. 209*)

In printing the motor lubrication route sheet for any given week, the entire master file of plates is run through the addressing machine. However, only plates tabbed for the frequency codes scheduled during that week will be listed on the sheet.

Whenever a new motor is purchased or an old one removed, a plate is added or removed from the master file. When the location of a motor is changed, the plate is changed accordingly to indicate the new building number, room number, or department number and is refiled into its new geographical position.

A balanced work load of motor lubrication for each week is maintained by lubricating each week one-fourth of the total motors requiring monthly lubrication, one-thirteenth of the quarterlies, one-twenty-sixth of the semi-annuals, and one-fifty-second of the annuals. In addition to serving as a work order, the motor lubrication route sheet serves as a report of work completed by the lubrication man. When a motor is lubricated, the exact date of lubrication is entered in the date lubricated column of the sheet.

Like most worthwhile programs, preventive maintenance requires planning and organization to make it effective. Given these essentials it will pay off both in dollar savings and increased efficiency for any company.

The Right Lubricant

(*Cont. from p. 204*)

tenance supervisor in the automotive fleet; they are most vitally concerned when lubrication is a problem. Where equipment builders are concerned the engineering department and service departments offer an opportunity for useful contacts. Regardless of his title it is always well, though often not too easy, to spot the individual responsible for equipment lubrication.

Lubrication engineers have grown in number and responsibility during the past 10 years. They have dispelled many of the mysteries surrounding lubricants for the user and have placed lubricant procurement on a more rational basis by pinpointing costs and inventories. Lubrication engineers have helped "sell" premium multipurpose lubricants where they believe their use to be justified, as they have also sold the modern idea of simplified lubrication.

Because of educational efforts by technical societies, such as ASLE, the designer of industrial plant equipment in particular is becoming increasingly aware of the importance of lubrication. From a survey carried out by *Product Engineering* covering 3,000 design engineers of whom 20 per cent responded, the following statements are abstracted:

> "88 per cent of the equipment when leaving the supplier's plants contains lubricant."
>
> "93 per cent specify lubricants, two-thirds by brand name, one-third by specification."
>
> "84 per cent of the respondents recommended to the buyers of their product the lubricant or lubricants, 55 per cent by trade name 45 per cent by specifications."

These figures indicate the importance of technical service to the equipment builders.

So far as the supplier's organization is concerned everyone engaged in customer contacts should be thoroughly indoctrinated in the importance of technical service. Often technical service is the primary responsibility of the marketing department, as it is closely associated with technical selling. Technical service as other marketing functions is decentralized. In the district it is intertwined with general marketing and sales duties. On the other hand, product application engineers in their frequent field contacts render valuable technical service and help the marketing staff in performing their duties, particularly where product quality and product testing are involved.

The concept of the right lubricant and the method of marketing has come a long way from the days when the oil salesman had little more to offer than a sample, a specification, and a price. Today, technical service, performance quality, and lubrication economics are the decisive factors which guide the plant lubrication engineer in deciding where to turn for his source of supply. With all due modesty the supplier can claim his share in the development of modern lubricants procurement.

LUBE LINES

(*Cont. from p. 195*)

tate the final decision as to the number and types of lubricants he should obtain if he himself becomes as familiar as possible with these conditions. He is living with them, he knows best how they may vary according to the idiocyncracies of certain temperamental units. This objective can be attained most successfully in the modern industrial plant where a standardized lubrication program is followed under the guidance of a capable lubrication engineer.

THE VALUE OF RECORDS

Present-day industrial plant lubrication engineers along with their counterparts—the specialists who represent the lubricant suppliers—are fully appreciative of the value of operating records. When these are assembled and presented to management in tabular form for study when simplified lubrication programs are being considered, the final decisions on number and type of products will be most adaptable to the ultimate protection of the machinery. The idea that lubrication is a job for the lowly "grease monkey" is now archaic. When we convert the "die-hards" from their philosophy that one machine oil or a single red engine oil is all that is necessary for plant bearings, it will be another step forward in emphasizing that lubrication performance is what counts.

The Right Time

(*Cont. from p. 212*)

most often used. Included on the cart should be the standardized devices used to make the application, along with a generous supply of fittings for replacement purposes.

No system is any good unless it is kept up to date. The machine scheduling system is no exception. Someone has to take care of the changes that take place from time to time on machine moves and production schedules. The system has to be adjusted accordingly. If this is done and if occasional checks are made to see that the system is functioning properly, it will greatly aid in getting the right lubricant to the right place at the right time and in the right amount.

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"Plant Lubrication and Lubrication Systems," by J. D. Lykins, Wheeling Steel Co., Wheeling, W. Va.

The practical aspect of plant lubrication relates directly to lubricant performance. Lubricants must be selected which will function most dependably under the prevailing operating conditions which have been cataloged according to machine details. This begins with a survey. Next, the lubricants are stored and dispensed to the systems of application. If this routine is followed with lubricants best suited to the service, maintenance should become a routine procedure of check-up, adjustment and recording of the machine's condition. Some wear must be expected, but the degree of wear is reduced materially by effective lubrication.

The plant lubrication engineer should be responsible for the survey which catalogs the machine details and operating conditions which dictate the type of lubricants to be used. Bearing materials, load conditions, speeds, temperatures and the possibility of contaminants are among the factors about which he should be informed. Contamination can be a vital deterrent to adequate lubrication; it can occur at the moment a tank car begins to unload, or the seal of a drum of oil or grease is broken. Contaminants, which can reduce the lubricating ability of a petroleum oil, a grease or an non-petroleum lubricant, can be solids such as dirt, or liquids such as water or a chemical gas. The principles of good housekeeping hold true in the oil house as well as in the home.

Lubricant application in the plant is most dependable when the means of lubrication is reliable, accessible, and capable of convenient regulation to control rate of feed. The modern centralized system for oil circulation or grease delivery is possessed of these attributes. The lubrication engineer must be quite familiar with the mechanical details of virtually any type of system. He must understand its operation, regulation, and maintenance and must be able to determine when and where any specific system can be used to best advantage.

The responsibility for maintenance depends on the machine or device which is to be maintained. Overall responsibility usually rests with the maintenance department which rightfully is responsible for the condition of the producing machine. But maintenance of lubricating equipment is more a function of the lubrication department when the storage and repair facilities are properly planned with adequate tools and spare parts for the lubricating equipment. Obviously the people most familiar with this equipment can keep it operating most dependably.

Training of lubrication personnel is a most important item in the organization of a plant lubrication department. Certain fundamental rules for survey, study of lubricant characteristics, methods of test, equipment details, machine construction, storage procedures, recording of lubricant consumption and reports hold true, regardless of the industry involved. Throughout, the lubrication engineer can be most valuable to his management when he can impart his knowledge to his own people and can impress upon them that plant lubrication is a most important adjunct to production, safety, reduced maintenance and machinery life. (*Digested by A. F. Brewer*)

"Automatic Centralized Lubricating Systems for Concrete Block Machines," by D. Knechtel, Besser Co., Alpena, Mich.

Quality as a measure of the strength, density and durability of concrete blocks is quite markedly affected by the manner in which the block making machinery is lubricated. The industry has come a long way from the prototype machine of 1904 which had production ability of some 200 blocks per day, to the modern daily output of 10,000 blocks. Design and engineering of course contributed to this progress, but it is safe to say that by realizing the importance of centralized lubrication the machinery builders incorporated an insurance factor which has promoted a greater extended life span of the operating parts.

The importance of positive automatic lubrication is accentuated by the fact that abrasive and possibly corrosive materials are being handled which can present a serious wear factor if they penetrate to the operating mechanisms. Cement, aggregates in the form of sand, gravel, volcanic ash, blast furnace slag or clay, along with water all are decidedly non-lubricating in nature.

Vibration is another detail which was considered when planning lubrication for the modern Vibrapac block machine. Vibration of the materials produces better compactness than used to be obtained by tamping. The effect is derived from cam operation with vibrating shafts attached directly to each end of the mold, using off-center weights to give vibration and place the settled aggregate in the mold.

These conditions of operation and design prompted block machinery manufacturers to study the applicability of centralized grease lubrication a little over 10 years ago. They met the problems of locating and securing the grease metering blocks by realizing that they must be designed to function under the built-in vibrating nature of the machine. In effect, while manufacturers of other industrial machinery endeavor to design to prevent vibration, the concrete block machinery manufacturer actually builds vibration into his equipment.

Later centralized air-borne lubrication was studied, the lubricant being applied as a fog or mist to the large sized sleeve type bearings which carried oscillating shafts turning at relatively slow speeds. Adequate atomization naturally is essential with this type of lubrication, hence the need for heating equipment in the system when the machine is to be operated in cold weather. The air supply must be dry.

Considering the limitations of other methods of lubrication, the block machinery manufacturer today indicates preference for the automatic centralized grease system on the Vibrapac machine where there are 75 points to be lubricated. With this type of lubrication, there are no inaccessible bearings which might be prevalent when manual lubrication is involved. All bearings receive the required amount of grease and there is virtually no chance for contamination of lubricant when handling and storage conditions are correct.

When it is realized that the cost of lost production of a high capacity block machine is around $1000 per day, the value of effective lubrication is evident. When the system is positive regardless of weather or temperature conditions and a multi-purpose lithium grease of E-P type is used, there is minimum possibility of separation at the metering blocks and pumpability is assured. The

concrete block machine is virtually a precision device, for all the seemingly rough appearance of the final product. Evidence of the maintenance of its productive ability is a tribute to the far-sighted judgment of the manufacturer and his realization of the insurance value of lubrication. (*Digested by A. F. Brewer*)

"Soluble Oils," by S. C. Zylstra, D. A. Stuart Oil Co., Chicago, Ill.

The physical phenomenon of emulsification has an interesting relationship to lubrication and the removal of heat in the process of metal cutting. Basically heat is the crux of the problem, as it results from the friction which is developed by sliding action of the chip over the cutting face of the tool in the course of metal cutting. As frictional heat can be detrimental to the cutting tool and to the surface of the workpiece, the objective is to remove this heat by the washing and cooling action of some form of cutting fluid. When it is realized that temperatures at the cutting edge can be as high as 2000F plus, this objective's importance is obvious.

Fortunately, however, the heat promotes a chemical reaction which is favorable to lubrication when sulfur and/or chlorine are included in the cutting fluid. These basic elements tend to react with freshly developed or nascent iron or steel surfaces to form chlorides or sulfides of iron which, at their respective melting points produce fluid films of great strength and load-carrying ability. The heavier the cut, the more pronounced is the need for adequate load-carrying ability, hence the practice of fortifying the cutting fluid with E-P additives. In the soluble oil type of cutting fluids, the inherent cooling ability of water is relied upon for temperature control. Within acceptable limits, the desired degree of lubrication is obtained through the emulsifiable oil content. In other words, the objective is to produce an emulsion or intimate mixture between the water and emusifiable oil, dispersed in each other in the form of fine droplets. Soluble oils when mixed with water produce emulsions of the oil in water type.

Soluble oil emulsions, however, while basically the same, will differ in appearance. Some are of the typically milky variety and practically opaque. Others of the colloidal type may be more or less translucent, while still others by virtue of their molecular dispersion are actually transparent. The size of the droplets is an important factor in regard to appearance and degree of translucence or transparency. In a typically milky type of soluble oil mixture the globule size will range from 0.10 micron up. In the more transparent mixtures the globule size will range from 0.10 micron to 1.0 millimicron, of even smaller. Authorities regard particle sizes smaller than 1.0 millimicron as molecular dispersion.

Balancing is important in the make-up of a soluble oil if it is to be uniform, clear and homogenous with no tendency towards separation. This requires a blend of oils and emulsifiers of such nature that when mixed with water a portion of the emulsifier will tend to tie in with the water, the other portion remaining in the oil. Through this dual action of solubility and the forces of cohesion and adhesion, together with the effects of surface tension and interfacial, a system is developed in which most complete dispersion of oil globules in water prevails.

The basic ingredients, therefore, are most important; but objectively one must look beyond the basic requirements of stability, cooling effect and lubricating ability. The modern soluble oil also must be possessed of quite a considerable degree of rust preventive ability; hence the addition of a chemically compatible rust inhibitor. The chemist studies this problem of rust prevention with due consideration of the water conditions because an anti-rust additive which would be effectual in one locale might be only partially effective in another due to difference in the hardness of the waters. This requires study of the potential chemical action between the calcium and magnesium salts in the water and the soaps which have been used in preparing the soluble oil. Any extraction of the emulsifier by these salts could weaken the emulsifying ability, promote instability and interfere with the normal processes occuring at the interface between the oil globules and the water phase.

Good detergency is another desirable feature in order to prevent build-up of fine grinding particles, the oil holding such particles in suspension to retard "loading" of a grinding wheel, for example. Detergency value is obtained by including a detergent type additive in the oil. This reduces the surface tension of water and imparts added wetting ability to the mixture. A good detergent solution will tend to creep into all the pores of the surfaces, even penetrating under accumulations of abrasive dirt, to loosen them, hold them in suspension and enable subsequent removal by the oil reconditioning system.

Bacterial growth also must be prevented by the soluble oil mixture, otherwise skin infections among operators could develop. So a third type of additive is included in the form of a bactericide. This will insure that the oil remains sterile by resisting bacterial growth which could be developed from the water source, or from not-too-cleanly conditions in service. While bacterial growth can be rapid, fortunately it is identified by objectionable odor.

To sum up, the modern soluble metal cutting fluid is a boon to the precision metal worker, especially where the desired additives are included to impart adequate lubrication, stability and protection of personnel. Care in handling, however, is most important. Just because it is received in sterile condition does not insure that the resultant mixture with water will be satisfactory, if mixing and agitation procedures are not in accord with good practice and capable of giving complete emulsification. The precautions are not complicated. They simply stipulate adding the oil to the water —never the reverse—with good agitation. They also stipulate never install a fresh emulsion in a dirty machine or central system. When the importance of cleanliness is realized, and the emulsifier the additives and the water are all compatible, the pay off will include extended emulsion life, longer tool durability and most dependable surface finishes. (*Digested by A. F. Brewer*)

Hydraulics for a Continuous Boring Type Mining Machine by J. J. Slomer, Goodman Mfg. Co., Chicago, Ill.

The use of hydraulics in mining machinery operation, as exemplified by the continuous boring machine, is subject to certain governing factors which relate directly to productive ability. These include:

1. Planning and location of the hydraulic circuit with due consideration to ease with which it can be serviced and adjusted.
2. Size of hose and fittings in accordance with volume of oil flow and desired pressure. There must never be excessive pressure drop.
3. Oil temperature control by judicious use of heat exchangers of ample cooling capacity.
4. Adequate knowledge and familiarity with functions of the respective circuits.
5. Realization that a suitable filter element, of the micronic type for example, can contribute to the life and dependability of the assembly of hydraulic components.

An important detail to remember in the design and operation of such machinery is that servicing at the working face is usual. When the machine is working three shifts per day, which means practically continuously, it is obvious that on the job maintenance and repair must prevail. When the electrician or mechanic is familiar with the details, limitations and ability of the hydraulic system, maintenance and repair usually can be kept in the minor category. With this in mind the mining industry today considers education of operating personnel to be a major objective. When the machinery builder realizes that success-

(*Cont. on p. 224*)

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Edited by W. E. Campbell

Selected literature compiled by members of the Technical Committees and Industry Councils of the Society.

"On Kinetic Friction between Unlubricated Metallic Surfaces," by F. F. Ling and Edward Saibel (Rensselaer Polytechnic Institute, Troy, N. Y.) Wear, v 1, n 3, 1957, pp 167-172.

The purpose is to show mathematically how the coefficient of friction of unlubricated or "dry" metals is dependent upon the energy required to form, as well as the energy required to fracture, a weld. The coefficient of friction f_w, resulting from welding, is found to be equal to (n/N) (s/p), where N is the total number of asperities in contact and n is the number which has welded, s is the shear strength of the junctions and p is the normal pressure. The factor n/N is related to the energies of the system. The author's final equation indicates that f_w is dependent upon the temperature of the junction and the sliding velocity. Qualitative conclusions drawn from the equations seem to follow known experimental results. (*Abstracted by Douglas Godfrey*)

"Why Abrasive Belts Need Grinding Fluids." J. J. Durnan, American Machinist, May 20, 1957, pp. 160-61.

Use of grinding fluids on abrasive belts improves surface finish and extends belt life by reducing "loading" of belt. Belt wear results from cyclic attrition then fracture of grits, but under dry heat metal can weld to grits and "load" belt. Coolants containing sulfur, chlorine, or phosphorus are desirable to prevent welding and to wash the belt, but they tarnish copper. The belt should be bonded to resist attack by coolant. The oil film cushions abrasion and yields finer finish, Low M.P. greases can also be used. Coolants in pressurized cans may be handy for short jobs. (*Abstracted by N. C. Morrell.*)

"An Application of Radioisotope Wear Study Techniques," by C. C. Gambill (Frigidaire Div.), General Motors Engineering Journal, v 5, n 2, 1958, pp 21-25.

Anti-wear characteristics of three oils in F-12 refrigeration compressors are measured. A description is given of the process for irradiating the vanes, which contain 20 mc of Fe^{59} each, and of the specialized handling equipment and test stands. Despite hold-up in the machines, oil samples gave a good indication of the relative wear allowed by each oil. It is stated that better counting techniques now available would allow less active vanes to be used, thereby simplifying handling and testing. (*Abstracted by M. L. Smith*)

"The Extreme-Pressure Lubricating Properties of Some Sulfides and Disulfides, in Mineral Oil, as Assessed by the Four-Ball Machine," by W. Davey and E. D. Edwards (Dept. of Chemistry and Biology, Regent Street Polytechnic, London, England), Wear, v 1, n 4, February 1958, pp 291-304.

Blends of sulfur and various sulfides and disulfides in paraffin oil are run in the four-ball machine. Diagrams are presented in which friction torque is plotted against load. The curves fall into three types depending on seizure and recovery characteristics. Before and after seizure at loads up to 120 kilograms, the friction torques for monosulfides and disulfides are the same. Above 120 kilograms the disulfides show higher friction torques. Diagrams are also presented in which mean wear scar diameter is plotted against load. The disulfides produce lower wear than the monosulfides. However, elemental sulfur generally produces the lowest wear. Two tables show that sulfur allows the highest load before welding takes place. The values are 270 kilograms for a sulfur concentration of 0.2 per cent and 340 kilograms for a sulfur concentration of 0.5 per cent. Disulfides allow welding at loads between 160 and 250 kilograms, and monosulfides allow welding at 120-150 kilograms. The authors' procedures for the preparation of nine additives are described in an appendix. (*Abstracted by Douglas Godfrey*)

"Flow Conditions and the Deformation Law of Viscous Plastics," by P. R. Paslay and A. Silibar. Oesterreichisches Ingenieur-Archiv 10, 4, Nov. 1956, pp. 328-44.

The problem of three dimensional flow of a Bingham body is studied and the corresponding deformation law derived. This solution is then applied to the problem of grease lubricated journal bearings. (*Abstracted by E. O. Forster*)

"Friction Experiments with a Soft Solid," by A. A. Milne (Thorntonhall, Glasgow, Scotland Wear 2, n 1, Aug. 1958, pp. 28-39.

The initial sliding friction of surfaces composed of a hard waxy grease has been found to be markedly dependent upon the length of time that the surfaces are loaded prior to sliding. The results may be interpreted in terms of the adhesion theory of metallic friction when due regard is paid to the rheological behavior of the material in the neighborhood of the contact areas. It is suggested that the results have implications for an understanding of time-dependent effects in the friction of other materials with particular reference to the observed variations of friction with sliding velocity. (*Abstracted by E. O. Forster*)

"The Mechanism of Friction and the Shear Resistance of Adsorbed Monomolecular Lubricant Films." Anita Bailey (Research Laboratory on the Physics and Chemistry of Surfaces, Univ. of Cambridge). Rev. inst. franc. petrole et Ann. combustibles liquides, v. 11, no. 10, 1956, 1313-24. In French.

Friction and wear are discussed in terms of the area of real contact. The experimental work described is conducted to measure the shear strength of a monomolecular film deposited on a molecularly smooth surface. The contacting surfaces are produced by pressing together cleaved mica bent and clamped to form crossed cylinders. The area of real contact is measured by an optical technique based on light interference fringes between the mica surfaces. The normal load and the force required to slide the surfaces together are measured. The shear resistance is calculated from the area of contact and the sliding force. For clean, unlubricated mica, the shear resistance is found to be 10,000 g. per sq. mm. The shear resistance for monomolecular films of calcium stearate deposited on the mica by the Langmuir-Blodgett technique is 250 g. per sq. mm. The author considers this value relatively high and an appreciable portion of the friction force in the lubrication of solids. She concludes that a significant portion of friction under boundary lubrication conditions could be the result of the shearing of lubricant films. This research is described in English in "The Area of Real Contact and the Shear Strength of Monomolecular Layers of a Boundary Lubricant," Anita Bailey and J. S. Courtney-Pratt, Proc. Roy. Soc. (London) v. 227, ser. A, 1955, 500-15. (*Abstracted by Douglas Godfrey*)

Patent Abstracts

Compiled by Ann Burchick
Aluminum Co. of America

Utilization of Mixtures of Organic and Inorganic Acids in the Preparation of Greases, Patent #2,864,766 (A. J. Morway, assignor to Esso Res. & Eng. Co.) A lubricating composition comprising a major amount of a lubricating oil, and an alkaline earth metal neutralized blend of five to 20 wt. per cent low molecular weight carboxylic acid having from about one to three carbon atoms per molecule and three to 15 wt. per cent mineral acid, and three to six wt. per cent aluminum soap, all of said weight percentages being based on the total weight of the lubricating composition.

Utilization of Sulphuric Acid in the Preparation of Fluid Lubricants, Patent #2,864,767 (A. J. Morway, assignor to Esso Res. & Eng. Co.) A fluid lubricating composition comprising a major proportion of lubricating oil and five to 50 wt. per cent of an alkaline earth metal base neutralized blend of a strong inorganic acid, a low molecular weight carboxylic acid having one to three carbon atoms per molecule and an intermediate molecular weight carboxylic acid having seven to 10 carbon atoms per molecule, wherein the mol ratio of said low to intermediate molecular weight carboxylic acid is about 3:1 to 20:1 and the mol ratio of the total inorganic acid and low molecular weight acid to said intermediate molecular weight acid is about 4:1 to 25:1.

Process for Producing Lubricating Oil Additives, Patent #2,864,846 (J. T. Gragson, assignor to Phillips Petroleum Co.) A process for producing a lubricating oil additive having both detergent and antioxidant properties which comprises subjecting a refined paraffinic lubricating oil having a viscosity of at least SAE 20 to oxidation in the presence of nitric acid having a concentration of 25 to 40 wt. per cent HNO_3 at a temperature in the range of 140 to 170F for a period of time in the range four to 10 hours, contacting the resulting oxidized oil with a sufficient amount of water so as to remove nitric acid; contacting the washed oil with a sufficient amount of alcohol so as to remove remaining water; contacting the washed and dried oil with from five to 15 wt. per cent of phosphorus pentasulfide for a period of time in the range one hour to four hours at a temperature in the range 300 to 400F; diluting a resulting product with an equal volume of benzene; contacting a resulting product with a saturated aqueous solution of an alkaline earth compound selected from the group consisting of alkaline earth hydroxides, oxides, and carbonates in an amount of 0.5 to 10 wt. per cent of the total charge; agitating the mixture for a period of time in the range of five minutes to five hours at a temperature in the range of 175 to 300F; filtering the resulting product so as to remove solid particles therefrom, and recovering the filtrate as the lubricating oil additive.

Electrical Insulating Oils and Method for Producing Them, Patent #2,865,849 (Mintje van Loon and Govert Verberg, assignors to Shell Development Co.) A process for the production of a non-gassing and oxidation stable electrical insulating oil from a mineral oil containing at least 35 per cent aromatics and 1 per cent sulfur and having a viscosity between one degree and nine degrees Engler at 20C comprising splitting the oil into portions (A) and (B), separately treating oil portion (A) by catalytically selectively hydrogenating the oil to substantially reduce the sulfur content without essentially effecting the aromatic content of the oil and separately treating oil portion (B) with a selective aromatic solvent to obtain a reaffinate fraction and subsequently treating these two oil portions (A) and (B) with sulfuric acid, removing the sludge from the acid treated oil portions (A) and (B), neutralizing the acid treated oil mixture (A) and (B) and thereafter treating the neutralized oil mixture (A) and (B) with a solid absorbent, the treated products of oil portion (A) and oil portion (B) being blended in proportion of from 80 to 40 parts by weight of oil (A) with from 20 to 60 parts by weight of oil (B).

Acid Neutralizing Lubricating Oil Compositions, Patent #2,865,857 (J. H. Walker, assignor to California Research Corp.) The process of forming stable, filterable lubricating oil compositions having base ratios in excess of four, comprising forming an admixture consisting of a dihydric alcohol having less than five carbon atoms, an inorganic substance selected from the group consisting of alkaline earth metal oxides and hydroxides, a filter agent, a lubricating oil, and from 0.3 per cent to 2 per cent weight, of an alkaline earth metal sulfonate, heating said admixture to a temperature in the range of about 250F to about 350F for a time sufficient to remove free dihydric alcohol, followed by filtration, and incorporating in the resulting filtrate a dihydric alcohol having less than five carbon atoms, an inorganic substance selected from the group consisting of alkaline earth metal oxides and hydroxides, a lubricating oil, from 0.3 per cent to 2 per cent, by weight, of an alkaline earth metal sulfonate, and a filter agent, heating the whole mixture to a temperature in the range of about 250F to about 350F for a period of time sufficient to remove free dihydric alcohol, followed by filtration, wherein said filter agent is a combination of glycolic acid and formic acid such that the glycolic acid is present in amounts of about 35 mol per cent to about 80 mol per cent in the glycolic acid-formic acid combination, said filter agent being present in amounts such that the mol ratio of said filter agent to said inorganic substance has a value from about 0.2 to about 0.5, and wherein the weight ratio of dihydric alcohol to said inorganic substance is from 30:1 to 10:1.

Alkyl, Hydroxyalkyl Cellulose Grease, Patent #2,865,858 (B. W. Hotten, assignor to California Research Corp.) A grease composition comprising a major proportion of an oil of lubricating viscosity, and, in an amount sufficient to thicken said oil to the consistency of a grease, an alkyl, hydroxyalkyl cellulose, wherein said alkyl radicals contain from two to four carbon atoms, and wherein said cellulose has an average from two to one alkyl radicals per glucose unit, and from one to two hydroxyalkyl radicals per glucose unit.

Solubilizing of Mineral, Vegetable, Animal Oils for Cosmetic, Pharmaceutical and Industrial Purposes, Patent #2,865,859 (Irwin I. Lubowe) A clear, non-aqueous solubilized liquid composition consisting of a low molecular weight aliphatic alcohol and an oil normally immiscible in said low molecular weight aliphatic alcohol and said oil and alcohol being made miscible and solubilized in each other by inclusion of a mixer composition including a low molecular weight aliphatic alcohol ester of a high molecular weight fatty acid, said first men-

tioned low molecular weight alcohol containing one-five carbon atoms and said oil containing 14-100 carbon atoms and said mixer composition including an ester of an aliphatic alcohol containing one-six carbon atoms and a fatty acid containing 10-24 carbon atoms and said ester constituting 5-35 per cent of the amount of the mixture of the first mentioned low molecular weight alcohol and oil, and said solubilized composition consisting essentially of 20-50 per cent of the oil, 20-50 per cent of the low molecular weight aliphatic alcohol and 5-20 per cent of the ester, by weight.

Quenching Oil Compositions, Patent #2,866,729 (C. F. Zimpel, assignor to Shell Development Co.) A quenching oil composition consisting essentially of a major amount of a mineral oil having a viscosity of from 100 to 200 sus at 100F containing from about 1.75 per cent to about 3.0 per cent of an oil-soluble copolymer obtained by reacting a cycloalkadiene hydrocarbon and a linolenic acid oil having an iodine value between 100 and 150 for 2-24 hours at a temperature of from 50 to 300C.

Ester-Base Lubricant Containing Non-Corrosive EP Agent, Patent #2,866,755 A lubricant composition of matter consisting essentially of an aliphatic carboxylic acid ester of lubricating oil characteristics and di(o-chlorophenyl) phenyl phosphate in an amount sufficient to impart E-P and anti-wear properties to said composition.

Lubricants Containing a Deposit-Control Additive, Patent #2,866,756 (R. Y. Heisler and S. R. Newman and K. L. Dille, assignors to The Texas Co.) A lubricating oil containing a glycol bis(glycol ether carbonate) having a carbon to oxygen weight ratio below 2.5 and a boiling point above about 650F.

Lubricants Containing Deposit-Control Additives, Patent #2,866,757 (S. R. Newman, R. Y. Heisler and N. Alpert, assignors to The Texas Co.) A lubricating oil containing a polymethylene glycol bis(glycol ether carbonate) having a carbon to oxygen weight ratio below 2.5 and a boiling point above about 650F.

Lubricants Containing A Deposit-Control Additives, Patent #2,866,758 (S. R. Newman, L. L. Dille, R. Y. Heisler and N. Alpert, assignors to The Texas Co.) A lubricating oil containing a carbonic acid diester of an aliphatic alcohol and of a polyglycol monoether.

Process of Lubrication, Patent #2,868,671 (J. A. Henricks, assignor to Devex Corp.) A method of lubricating metal surfaces of internal combustion engines that are subject to a substantially uniform continuous sliding friction, comprising introducing upon a porous wearing surface a polyhydric alcohol selected from a member of the group consisting of glycerol, glycol, glucose, starch and cellulose, introducing a glass forming acid selected from a member of the group consisting of boric, arsenic and phosphoric upon said wearing surface, and thereafter forming a lubricating film in situ upon said wearing surface.

Salts of Acrylamide-Acrylic Acid Ester Copolymers as Grease-Thickening Agents, Patent #2,868,728 (B. W. Hotten and W. Lowe, assignors to California Research Corp.) A grease composition comprising a major proportion of an oil of lubricating viscosity and, in an amount sufficient to thicken said oil to the consistency of a grease, an alkali metal salt of a copolymer of (1) an ester of acrylic acid, and (2) an alpha-substituted acrylamide, wherein the mole ratio of (1) to (2) is from 3:1 to 6:1, wherein said alpha substituent is an aliphatic radical having from one to two carbon atoms.

Lubricating Oil Thickened to a Grease with an Anhydrous Calcium Soap of an Alkenyl Substituted Succinic Acid, Patent #2,868,729 (J. W. Nelson and J. A. Verdol, assignors to Sinclair Refining Co.) A lubricating grease including a mineral lubricating base oil and sufficient to thicken the base oil to grease consistency of an anhydrous calcium soap of an alkenyl substituted succinic acid in which the alkenyl substituent contains at least 14 carbon atoms.

Insulating Oils, Patent #2,868,730 (J. C. Wood-Mallock and F. Hughes, assignors to Manchester Oil Refinery (Holdings) Ltd.) A new insulating transformer oil composition consisting essentially of a mineral transformer oil, and: (a) a compound selected from the group consisting of anthranilic acid and o-phenylene diamine in an amount effective to function as a metal deactivator in the transformer oil, and (b) a compound selected from the group consisting of phenyl-alpha-naphthylamine and phenyl-beta-naphthylamine in an amount effective to function as an anti-oxidant in the transformer oil.

Open Gear Lubricants, Patent #2,870,089 (J. F. McGrogan, assignor to The Atlantic Refining Co.) A lubrication grease having extreme pressure properties consisting essentially of a major amount of a partially oxidized liquid residual asphalt and a minor amount, sufficient to thicken said asphalt, of the reaction products formed in said asphalt of hydrogenated marine fatty acids and sodium hydroxide, together with graphite and a methyl ester of lard oil, in minor but in sufficient amounts to impart extreme pressure properties to the thickened asphalt.

Method of Grease Manufacture Comprising Shearing, Patent #2,870,090 (H. J. Pitman, W. E. Jordan, Jr. and G. S. Bright, assignors to The Texas Co.) The method of grease manufacture which comprises cooling a mixture of lithium hydroxy fatty acid soap and oleaginous liquid in grease-forming proportions to a temperature below its phase transition temperature range and then subjecting the said grease mixture to a limited amount of shearing, represented by an amount of work below about 1000 foot pounds per pound of finished grease, by passing the said cooled grease mixture through a shear valve with a pressure drop of about 15-200 psi across said valve, with substantially no additional working of the grease during the finishing process.

Greases Stabilized with Organic Carbonates, Patent #2,871,191 (J. E. Schott, assignor to Socony Mobil Oil Co., Inc.) An alkaline earth metal soap grease normally susceptible to gel structure deterioration, having in admixture therewith a small amount, 0.01 per cent to about five per cent, of di(butoxydiethylene glycol) carbonate.

Anti-Friction Bearing Grease and Preparation Thereof, Patent #2,872,416 (A. J. Morway, assignor to Esso Research & Engineering Co.) The process of preparing a high temperature grease having long lubrication life in anti-friction bearings which comprises preparing a base grease by heating a mixture of about 29 wt per cent on base grease, of rapeseed oil and about 32 wt per cent, on base grease, of a refined Coastal distillate oil of 500 SSU viscosity at 100F and 40 viscosity index to about 150F, adding about 0.8 wt per cent, on base grease, of sodium petroleum sulfonate, adding about 5.9 wt per cent, on base grease, of sodium hydroxide as a 40 per cent aqueous solution, heating the mass to about 350F to dehydrate the same, adding about 31 wt per cent, on base grease, of said Coastal oil, raising the temperature to about 500F, rapidly cooling the mass to about 275F within about four hours, adding about 1.5 wt per cent, on base grease, of inhibitors and further cooling to about 200F; blending the base grease so prepared with an about equal weight of a blend of about 8-9 wt per cent, based on total grease, of a solvent refined, propane precipitated Mid-Continent residuum of about 2200 SSU viscosity at 100F and about 100 viscosity index with about 39-40 wt per cent, based on total grease, of a solvent refined Mid-Continent distillate of about 367 SSU viscosity at 100F and about 102 viscosity index; and homogenizing the grease so prepared at high rates of shear of about 10,000-500,000 reciprocal seconds.

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SECTION NEWS

Baltimore—Pierce Hollingsworth, Koppers Co., Inc., presented his paper "Gear Couplings, Their Design and Application" at April 9 meeting. . . . **Boston**—Members and guests heard talk by Admiral Howard at Boston Naval Shipyard on April 13, afterwards toured the shipyard's machine and forge shops. Later at regular evening meeting, Nevin T. Brenner discussed "Lubrication of Earthmoving Equipment." A joint dinner meeting with members who attended the educational course on metal cutting and grinding was held March 16 with Dr. Karl T. Benedict explaining "Dermatitis and Toxicology of Cutting Fluids." . . . **Hudson-Mohawk**—"Hydraulic Oils and Their Application" was title of paper presented by Shell Oil Co.'s A. S. Morrow at March 18 meeting. . . . **Kansas City**—"Selection and Care of Modern Hydraulic Fluids" was discussed by K. G. Henrikson, Mobil Oil Co., at March 24 dinner meeting. . . . **Saginaw**—After April dinner meeting, Jack Newlove gave an informative talk on hydraulic pumps. **New York**—A forum on lubricants and lubrication held April 8 gave members and guests a chance to question authorities in the field. Panel members were W. Eisman, E. F. Houghton Co.—Hydraulic Fluids, L. E. Hoyer, American Brake Shoe Co.—Bearings, R. W. Meals, Sinclair Refining Co.—Automotive Lubrication, F. Mrozek, Acheson Colloids Co.—Solid Lubricants, J. Murray, Esso Research and Engineering Co.—Metal Working Lubricants and C. W. Nichols, Mobil Oil Co.—Oils and Greases. . . . **Syracuse**—Cocktails were served before March 16 buffet dinner. John Lock, Sinclair Refining Co., discussed "Quenching Oils.". . . **Toronto**—Approximately 35 members and guests enjoyed Acheson Colloids Co.'s A. J. Stock's talk on the company's new Emralon coatings. **Twin Cities**—On March 26, R. K. Sedgewick presented his paper on "problems of Way Lubrication on Servo Controlled Machines." . . . **Chicago**—March meeting of special interest to purchasing agents. Westinghouse's George Duke, himself a purchasing agent, discussed "The Right Lubricant at the Right Price (on page 213 of this issue). Dinner and cocktails preceded Duke's talk.

ASLE TECHNICAL DIGEST

(*Cont. from p. 219*)

ful performance of any hydraulic circuit depends on proper selection of motors, pumps, cylinders and valves in accordance with pressure, speed, direction and volume of fluid involved, direct benefits accrue to the operators. It is another example of modernization, with personnel as well as machinery in mind. (*Digested by A. F. Brewer*)

Note: Unabridged copies of the foregoing papers are not available at Society headquarters. Those wishing additional information about these papers should contact the author.

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Trabon lubricates world's 3 largest ladle cranes

So big they carry enough molten steel to make 750 complete automobiles. So huge they tip the scales at nearly 6 million pounds. Yes, 3 Morgan 500-ton cranes are now doing a gargantuan job at a famous Eastern steel plant. And all three cranes and their 1476 vital bearings are protected by Trabon centralized lubricating systems.

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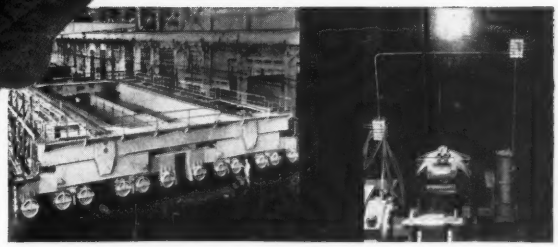

One of the three giant Morgan ladle cranes prior to being outfitted with Trabon Centralized Lubricating Systems. Note immensity of the lubricating job if it had to be done manually.

Trabon automatic lubricant pump, two feeders and lubricant lines. Note cam in right foreground which automatically starts the lubricating cycle while crane is in operation. No auxiliary machinery is necessary. Trabon is easily and economically installed on hydraulic, mechanical, electric motorized and pneumatic equipment.

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